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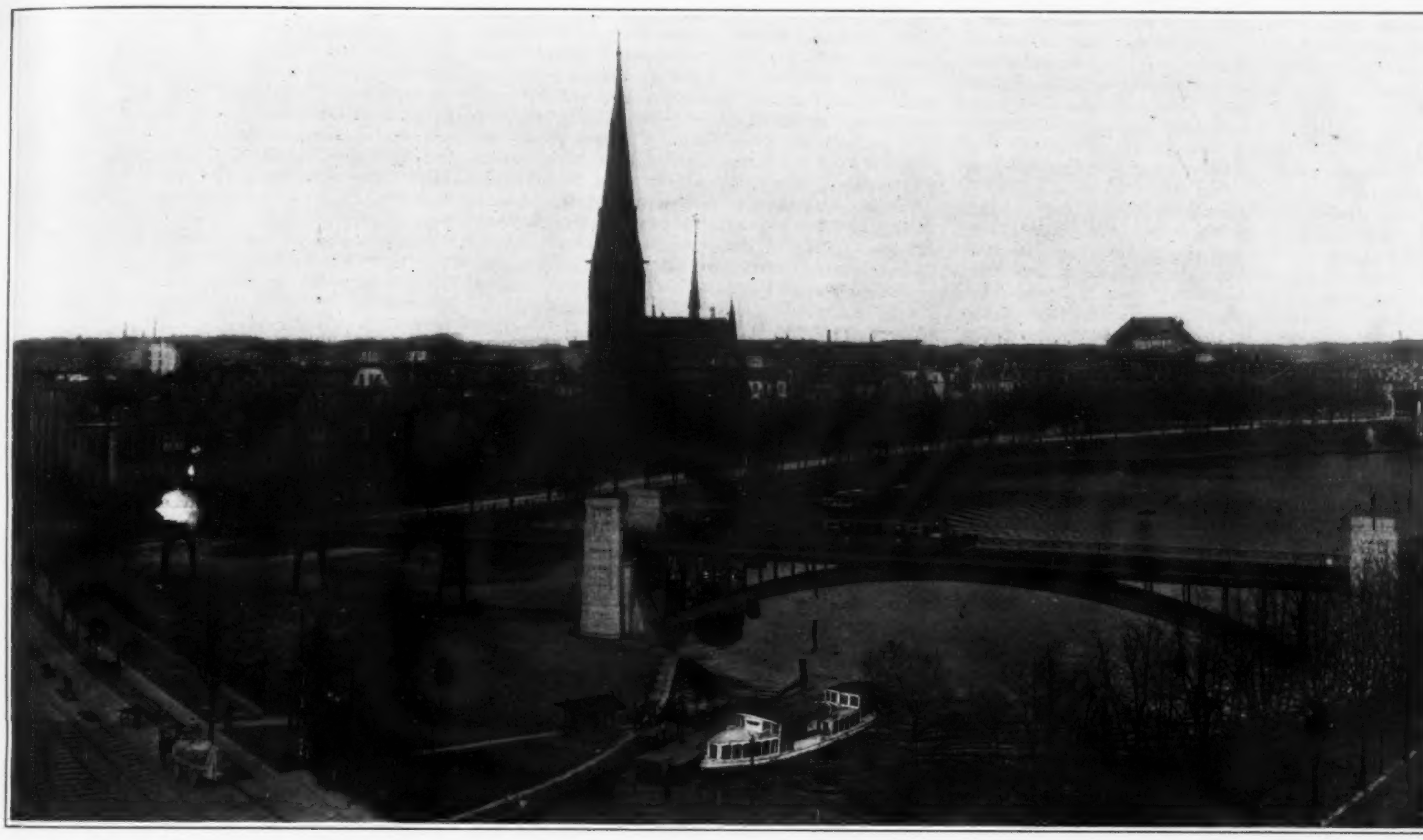
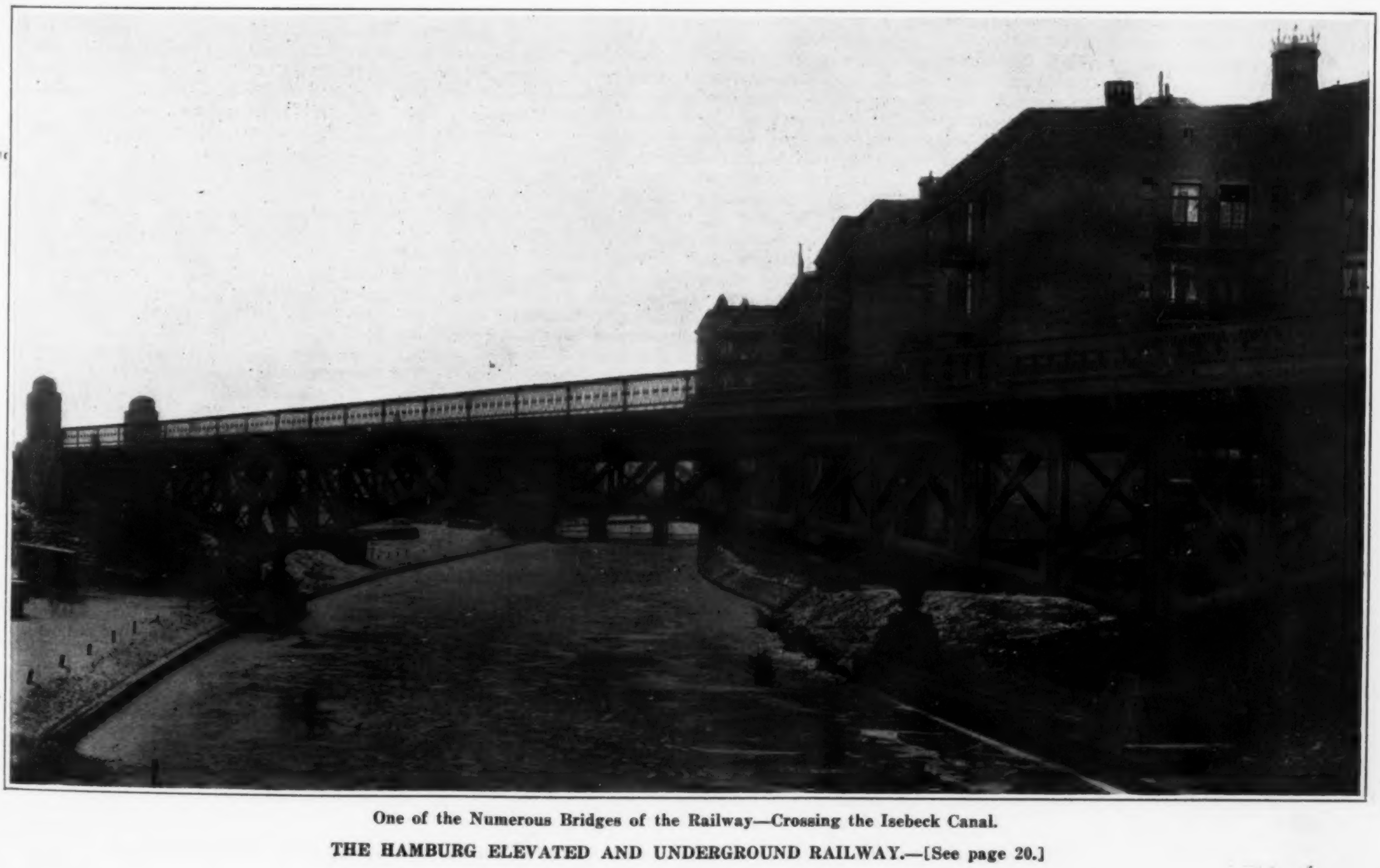


View of Hamburg Across the Isebeck Canal.



One of the Numerous Bridges of the Railway—Crossing the Isebeck Canal.

THE HAMBURG ELEVATED AND UNDERGROUND RAILWAY.—[See page 20.]

Our Record-breaking Crop

The Figure for 1912 Reaches Nine and a Half Billion Dollars

The sixteenth annual report of the Secretary of Agriculture, recently made public, begins with a series of short paragraphs in which some important agricultural truths are strikingly expressed. It proceeds with the customary review of the agricultural production and foreign trade of the year and contains some results of an investigation into local conditions affecting agricultural credit, the usual condensed statements of the work of the bureaus during the year, and a long account of the work and achievements of the department during the 16 years throughout which Secretary Wilson's service has extended.

BRIEF COMMENTS.

What are termed brief comments are expressed as follows:

The most effective move toward reduced cost of living is the production of greater crops. This is attributable to the work of the Department of Agriculture, the agricultural colleges and experiment stations, and the help of the press in publishing every movement to help the farmers. Demonstration work in southern States in the fields has been of immediate benefit. The South has increased the food supply very much in the last few years. The movement ordered by Congress to take farm demonstration into all Northern States will bring more food into our markets. Our fields can and will steadily increase their output in coming years as ways and means of growing heavier crops become better understood. The Nation forgot its farmers in the general scheme of education of past years; few philanthropists thought of them when giving for education. Congress is good to them. They are waking up and thinking for themselves.

The sugar crop from the beet was 600,000 tons a year ago; it is 700,000 tons this year. The sugar comes from the carbon-dioxide of the atmosphere, taking no valuable plant food from the soil. The process of growing is intensive agriculture, something new to all but our gardeners, and prepares the soil for increased yields of all other crops.

One hundred and sixty-three thousand square miles have been cleared of the fever tick in the Southern States, equal to the area of three States. The farmers there are bringing in improved stock and will soon contribute materially to the meat supply.

Seven hundred acres of Egyptian and other long-staple cotton are being grown on the Colorado River in southern California, under research conditions that give good promise of eventually supplying the demand for such fibers. Thread makers of Europe are here inquiring into future supplies of long-staple cotton. The market waits for the scientist to do his work.

When the Panama Canal is open for business our bulbs and beet seed will come from the Pacific coast.

The leading specialists of the Department of Agriculture educate their assistants. The outside world wants them and pays more than the law permits being paid in the Government service.

The Food and Drugs Act is exacting on department time; 1,459 violations were sent to the Department of Justice during the last year—25 per cent more than in the year before. Jail sentences are now being imposed.

Our farmers get only half crops on the average, or 10 tons of beets from an acre. They are learning how to farm intensively and will grow twice this tonnage in a few years, when they will not fear reduction of duties.

Our dry-land problems will be measurably solved through alfalfas from Siberia and nonsaccharine sorghums from Africa.

Congress has given us law to keep out diseased and insect-infested plants.

Farm demonstration in the fields is being organized in all the Northern States, Congress providing.

The field is the best classroom for instruction in practical agriculture.

Department study of poultry and eggs will help to get these foods to market in good condition.

The sea is the great reservoir of potash. The kelp plant gathers it. We gather the kelp and extract.

Two feet of woven wire and three barb wires keep dogs out of a sheep pasture. Dogs outnumber sheep in many States, and we have not learned to eat dogs as they do in some European countries. The reason given by most farmers why they do not keep sheep is "the dogs." Kansas had, in 1910, 175,000 sheep and 199,000 dogs, Coburn tells us.

The town does not need the retired farmer, while the farm needs his experience and his capital. A retired farmer is capital going to waste.

Taking care of the soil is the first consideration in conservation of our resources.

Denmark buys our mill feeds and sells $40,000,000 of dairy products to Great Britain.

Bookkeeping will soon be as common on the farm as in the factory. It is just as important for a farmer to know what it has cost to produce a given crop as for the manufacturer to know the cost of making the article he sells.

MOST PRODUCTIVE OF ALL YEARS.

Most productive of all agricultural years in this country has been 1912, declares the report. The earth has produced its greatest annual dividend. The sun and the rain and the fertility of the soil heeded not the human controversies, but kept on working in cooperation with the farmers' efforts to utilize them. The reward is a high general level of production. The man behind the plow has filled the Nation's larder, crammed the storehouses, and will send liberal supplies to foreign countries.

The prices at the farm are generally profitable and will continue the prosperity that farmers have enjoyed in recent years. The total crop value is so far above that of 1911 and of any preceding year that the total production of farm wealth is the highest yet reached by half a billion dollars. Based on the census items of wealth production on farms, the grand total for 1912 is estimated to be $9,532,000,000.

During the last 16 years the farmer has steadily increased this wealth production year by year, with the exception of 1911, when the value declined from that of the preceding year. If the wealth produced on farms in 1899 be regarded as 100, the wealth produced 16 years ago, or in 1897, is represented by 84, and the wealth produced in 1912 by 202.1. During the 16 years the farmers' wealth production increased 141 per cent.

The wealth production on farms during the last 16 years reached the grand total of more than $105,000,000,000. This stream of wealth has poured out of the farmers' horn of plenty, and in 16 years has equaled about three-quarters of the present national wealth.

CHIEF CROPS.

A field half as large again as Italy or nearly as large as either France or Germany is the area of this country's cornfield. This year's corn crop is the largest ever produced in this country, and reaches the staggering amount of 3,169,000,000 bushels. In value, too, the corn crop of this year is the highest on record, and reaches the fabulous amount of $1,759,000,000. This crop is worth to the farmer 20 per cent more than the average corn crop of the previous five years.

Hay has returned to its old place and is the crop that is second in value. The year was most productive for grass and hay, and the harvest of hay is measured by 72,425,000 tons. This is 16 per cent above the average crop of the previous five years. The value of this year's hay crop is $861,000,000, and has never been equaled. It exceeds the five-year average by 21 per cent. The importance of this crop to the farmer is better realized when it is observed that its value is greater than that of the cotton crop and nearly as great as the combined values of the wheat, tobacco, and potato crops.

The report states that there is general agreement throughout the country that the cotton crop will be next to the largest one in production and is likely to exceed the average crop of the five preceding years. It is estimated that the lint cotton of 1912 may be worth $735,000,000, an amount that exceeds that of 1911, although the crop of that year was much greater than this year's crop. It is stated in the report that cotton often demonstrates the frequently observed fact that the crop of excessively high production may not be worth as much in the aggregate as the one that is about sufficient for the requirements of consumption. Farmers in their collective action endeavor to produce about the quantity of a crop that they can market at profitable prices. An experience of years gives them a rough sort of judgment with regard to this quantity, but they can not foresee what the weather will do to their crops. Having made their planting and sowing plans, it may be assumed, with fairness to themselves and also to consumers, the crop suffers under unforeseen adversities, there is inadequate production, and the general conclusion is that the agriculture of the country is unable to meet national requirements. This conclusion, however, is soon forgotten, and, as a prominent live stock paper has recently stated, "Given three years of real farm plenty, and prophets of dwindling food supplies in comparison with population will take down their signs."

The seed out of the cotton crop of this year is estimated to be worth about $117,000,000, or over 6 per cent more than the five-year average, but its value has been exceeded by the crops of three preceding years. The combined value of the cotton lint and seed is estimated to be $860,000,000, or about one half the value of the corn crop and a little less than the value of the hay crop. In value as well as in production the cotton crop of this year has been exceeded by only one year, and that was 1911 for production and 1910 for value.

The wheat crop is estimated to be worth $596,000,000, an amount which was exceeded by the value of the crops of 1909 and 1908, but no other year. The quantity of the crop, 720,333,000 bushels, is 11.2 per cent greater than the average production of the previous five years and has been exceeded by the crops of only two years. It is only 15,000,000 bushels below the next higher crop and only 28,000,000 bushels below the highest production.

The oats crop is fifth in order of value. Although the price has declined, the production is so enormous that the value of the crop is estimated to be $478,000,000, or a little more than one half of the value of the entire cotton crop. The remarkable production of 1,417,172,000 bushels was 51.5 per cent greater than the average of the preceding five years.

The potato crop is another one of highest production. Its 414,289,000 bushels are above the five-year average by 29 per cent, but the crop is worth only $190,000,000 on account of low prices. Three previous smaller crops have been more valuable.

With a production of 224,619,000 bushels, the barley crop far exceeds the largest one heretofore produced. It is 35.7 per cent above the average production of the five preceding years. The value of this year's crop, $125,000,000, is below the value of the crop of 1911, although the production of that year was 64,000,000 bushels less.

The tobacco crop has not quite risen to the high level of production of most of the other crops, yet it amounts to 959,437,000 pounds and is 7.1 per cent above the average of the preceding five years. The price has risen somewhat, so that the total value of the crop, $97,000,000, is about 11 per cent above the five-year average.

Flaxseed is the most valuable of the smaller crops, the amount for this year being about $39,000,000, or 32.4 per cent above the average value of the five preceding crops. The production is 29,755,000 bushels.

Rye is one of the crops that remain nearly stationary in production. This year's crop contains 35,422,000 bushels and is the largest one produced. Its value is $24,000,000.

The rice crop is about 8 to 10 per cent above the average production and would have been much greater had it not been damaged by the Mississippi River freshet. The value may amount to more than $20,000,000.

The buckwheat crop is the largest since 1868 and amounts to 19,124,000 bushels, worth $12,000,000.

Extraordinary conditions of the world's hop market in 1911, on account of deficient European production, have not been repeated this year. It is estimated that the crop of 44,500,000 pounds is worth about $11,000,000.

All of the cereals, except wheat and rice, produced their largest crops in 1912 and, including those crops, made a gain of 25.6 per cent above the five-year average. The total production of the seven cereals is 5,609,807,000 bushels, a value of this great mass of cereals is a little over $3,000,000,000 and is 15.8 per cent above the average of the previous 5 years.

Sugar beets and sugar cane are treated from the point of view of sugar manufacture. The raising of sugar beets for sugar making can hardly be regarded as being an established industry 16 years ago. Under the encouragement of the law, this department and other agencies promoted the growth of this industry. The latest fruition of all these efforts, declares the Secretary, appears in the magnificent testimonial of the production of 1912. The beet-sugar crop of 1899 amounted to 81,729 short tons. It increased to 218,406 tons in 1902, to 501,682 tons in 1909, and to 599,500 tons in 1911. The production of 1912 amounts to about 700,000 short tons, or a gain of about 100,000 tons over the preceding year. The beet-sugar production of 1912 is about one fifth of the national consumption of sugar, and, declares the report, illustrates what can be done under the protection of the law and in consequence of practical and well-directed efforts. If the by-products of beet sugar manufacture are included, the value of this industry in 1912 is about $67,000,000.

The cane-sugar industry fared badly on account of the Mississippi River flood. The production of sugar is the lowest since 1899, and the value of all the products of the industry is only about $34,000,000.

If to the value of the products of the beet and cane sugar industries are added the value of the sorghum syrup and maple sugar and syrup made on farms the total is about $117,000,000.

The year 1912 was a record-breaking one for crop production and crop values. Only two crops had been exceeded twice in former production, and these are wheat and tobacco. Only two crops had been exceeded once in production, and these are cotton and rice. All of

the other crops stand at high-water mark—all of the cereals but wheat and rice, the great hay crop, potatoes, flaxseed, and beet sugar.

With respect to value, the only crops that have been exceeded three times are potatoes and cotton seed. The crops exceeded twice in value are wheat, cotton seed, tobacco, and rye, and the crops that have been exceeded once in value are cotton lint, beet sugar, and buckwheat. All the other crops reached their highest value in 1912, and these include all of the cereals except wheat and rye, the prominent hay crop, flaxseed, and beet-sugar by-products.

LIVE-STOCK PRODUCTS.

The dairy cow is one of the principal products of wealth on the farm, and the value of her products in 1912 is estimated at about $830,000,000, an amount which exceeds the value of the cotton lint and is nearly equal to the combined value of lint and seed. The wheat crop is worth only three fourths as much as the dairy products.

The magnitude of the poultry industry is set forth. An egg may be worth only a cent and three quarters, and yet 1,700,000,000 dozen eggs are worth $350,000,000, and these are the estimates for 1912. If to the value mentioned is added the value of the fowls raised, the products of the poultry industry on farms amounts to about 570,000,000. This is nearly equal to the value of the wheat crop and is more than three fourths of the value of the cotton lint produced this year.

The animals sold from the farm and the animals slaughtered on it together number about 111,000,000, and the farm value of these animals is estimated at $1,930,000,000.

The total value of the animal products of the farm in 1912 is estimated to be about $3,395,000,000. This is a larger value than that of 1911, but is about $150,000,000 below the estimate for 1910, which is the only year that exceeds 1912 in value of animal products produced on farms.

While animal products were about one third of the wealth production on farms in 1912, the crops were about two thirds. Their value was $6,137,000,000, an amount which is vastly above the high-water mark of total crop value in 1911.

PRICES OF FARM PRODUCTS.

Some attention is given to the trend of farm prices of farm products during the last 40 or 50 years, as contained in the records of the department. The concluding observation is that there was a general downward movement of prices from the Civil War until it was arrested in the nineties. The subsequent elevation of prices has sometimes carried them to about the level of the earlier years under review, and sometimes higher. But, "it may be noticed that, if comparison is made between present prices and the extremely and abnormally low prices of the nineties, the present period of high prices is made by force of comparison to occupy a relatively higher place than it does if comparison is made with the high-price periods preceding."

FOREIGN TRADE IN FARM PRODUCTS.

Over a billion dollars is for the fourth time the value of the exports of farm products. They are sufficient to pay the expenses of the National Government. The billion-dollar mark was first reached in 1907, when the value of the agricultural exports amounted to $1,054,000,000. That amount has not since been equaled, but the exports of 1908 and 1911 exceeded a billion dollars in value, and in 1912 the amount fell short of the record exports by only $4,000,000.

The high value of exports is not entirely due to high prices. The report then proceeds to examine the trend of the exports of the agricultural products and finds a considerable number of them increasing in quantity. Among these are oleo oil, lard compounds, various animal oils not especially described, eggs, and mutton. If regard is paid to the last three years, the exports of cured pork hams are found to increase and to be near the former high level. Lard is another commodity that has been climbing back to former importance. The report asserts that if the exports of pork and of all of its products are consolidated, it will appear that they are rapidly returning to the average of the high period of 1900 to 1909.

Cotton is the great mainstay of the export trade and marked increase in its exports is conspicuous. Apples are supporting an increased export trade, which now amounts to about $10,000,000, both dried and fresh apples being included. Prunes are a fruit that has reversed the tide of international trade, and raisins are in the same class.

To the list of commodities whose exports are increasing and are above the average of 10 years 1900 to 1909, or very close to that average, may be added glucose and grape sugar, hops, corn-oil cake, cottonseed-oil cake and oil-cake meal, flaxseed-oil cake and oil-cake meal, cottonseed oil, linseed oil, rice, cottonseed, tobacco, and the four vegetables—beans, peas, onions, and potatoes.

Beef and its products have gone into a sorry decline in the export trade, but wheat flour still maintains a high relative showing, as is indicated by 71 in comparison with 100 standing for the annual average of the 10 years 1900 to 1909, and has steadily increased in exports during the last three years.

Packing-house products have declined in value of exports since 1906, when they reached the high value of $208,000,000, and have declined still more so in quantity because of the increasing prices; but the value of packing-house exports has increased since 1910, and reached the amount of $164,000,000 in 1912. Although the exports of grain and grain products are now below the maximum amounts of the values of some years ago, the value of these exports in 1912 was $123,000,000.

The balance of trade in favor of exports of farm products was $278,000,000 in 1912. The favorable balance has been declining since 1908 for the reason that the imports have increased faster than exports.

The various forest products exported in 1912 were valued at a grand total of $108,000,000 and the imports at $173,000,000.

"The American Danger"*

How Germany Views Our Automobile Industry

The following article, from the *Berliner Zeitung am Mittag* reflects in an interesting manner Germany's attitude toward American automobile manufacturers:

"A number of articles have appeared in the press lately calling attention to the 'American peril' that menaces our automobile industry. The opinions expressed are widely divergent and while it is pointed out that Americans, in spite of their production in large quantities at a resultant low cost, can never seriously menace our home industry on account of the opinion prevailing that low prices indicate an inferior quality, it is conceded, however, from other sources that this low price will go a long way toward launching American cars on the market.

"As a matter of fact, the Americans have established themselves in practically all the South American countries and, in the last few years, have almost entirely supplanted European manufacturers. Recently they have turned their attention to England and are gaining ground in that country with surprising rapidity. The principle of the American manufacturer is to make his price as low as possible by manufacturing in large quantities, in some cases 40,000 to 60,000 cars a year, and by delivering the car complete and ready for the road; indeed, a complete car may be purchased for 4,000 to 4,500 marks (1,000 to 1,125 dollars). These low prices have made the automobile very popular in America and have stimulated an increased demand. Taking into consideration the different economic value of money here and in the United States, it will be seen that these prices are really lower in America than they seem to us.

"This production in large quantities, with its accompanying lowering of the price, naturally results in a wider market, which in turn increases the demand, which again reacts upon the output. This high output makes possible a reduction in the cost of production, at a still lower price. So we have a steady cycle, tending to lower prices, which, however, will find its limit in the cost of raw material and labor.

"Another factor is that Americans specialize on two types (20 and 30 horse-power), so that the cost of the constituent parts is thus further reduced. The short space of time required for delivery is also of great importance. In America, in a great majority of cases, the owner drives his own car and has no chauffeur, so it is easy to understand that many now have cars who a few years ago regarded them as a great luxury.

"Owing to their low price, it is often deduced that American cars are constructed from poor materials and can therefore furnish but a limited service. This, however, is not the case; indeed, the bad condition of American roads soon showed the manufacturer that only by using the best materials could he compete with his rivals in trade.

"The Americans' constantly varying needs and their severe use of all machinery mean that a car is not expected to have as long a life as in this country. In America, when a man has used a car three years, he sells it and buys another.

"It cannot be gainsaid that Americans, in their ceaseless search for new markets for their tremendous output will seriously menace our industries. This is already shown by the fact that several selling agents in Germany expect to handle American cars this coming year."

THE EXTENT OF THE DANGER.

Figures just completed by the Division of Statistics of the Bureau of Foreign and Domestic Commerce show that the exports of automobile to foreign countries in the fiscal year 1912 were valued at $21,500,000, and of parts thereof, including tires, at $6,750,000. If to these are added the shipments to Hawaii and Porto Rico, we get for the year sales of American automobiles outside of continental United States of fully $30,000,000, as against only $1,000,000 worth a decade ago. The total number of machines exported to foreign countries was 21,757, valued at $21,550,139, averaging slightly less than $1,000 each, while those to the non-contiguous territory were higher, averaging $1,600 each. The export price of American automobiles in 1912 averaged less than in any earlier year in history of the export trade. The average for 1912, dividing the total number of machines exported into stated value, was $990 each, against $1,100 in 1911, $1,380 in 1910, $1,700 in 1909, and $1,880 in 1908. On the import side the automobiles imported last year amounted to but about $2,000,000 in value, against more than $4,000,000 in 1907. The export price of American machines has fallen from $1,880 in 1908 to $990 in 1912, while the import price of foreign automobiles entering the country has only fallen from $2,392 in 1908 to $2,216 in 1912, the reduction in price on the export side being 47 per cent and on the import side but 8 per cent. English-speaking people are the chief purchasers of American automobiles. Of the 21,757 exported in 1912, 6,288 went to Canada, 5,716 to the United Kingdom and 3,625 to Australia and New Zealand; the next largest number, 1,611, being credited to South America, while European countries other than the United Kingdom took 2,296. Of the 963 automobiles imported into the country in the fiscal year 1912, 401 were from France, 188 from the United Kingdom, 131 from Italy, 116 from Germany and 127 from all other countries.

* From the Bulletin of the American Association of Commerce and Trade.

A Multi-cellular Tire

The inner tube problem is as old as the pneumatic tire, but no thoroughly satisfactory solution has as yet been found. A great variety of devices have been patented, and in some instances placed on the market, which have more or less merit, and which seem to bear some promise of furnishing at least a partial solution of the problem.

A tube which deserves our interest in this connection is built up of compartments on the multi-cellular plan. The fundamental principle of this tire is the old idea of dividing a large space into several smaller spaces, still retaining the efficiency of the larger. This is the principle of the tubular boiler, water-tight compartments of battleships, the separate gas bags in the Zeppelin airships, etc. The tube is to replace the present inner tube, being used in the shoe as an inner tube. The whole tube is first divided into ten sections. Each section is made up of about 30 cells. The section is put in a patented machine which fill all the cells with air compressed at any desired pressure. At the same time a cap of rubber and fabric is vulcanized to the section, sealing the open end, and imprisoning the air in the section.

A V-shaped cut in the rim section of the tube takes up the expansion of the rubber when inflated, and when the section is in a shoe, holds the beading of the shoe on the rim.

To put a tire on a wheel, ten of these sections are placed in a shoe, then with an ordinary tire iron or C clamp the points of the V are drawn together and the beading of the shoe is slipped under the rim. The force of the V is sufficient to hold the shoe to the rim, thus doing away with the necessity for all lugs and bolts.

It is claimed that with such an inner tube blow-outs are an impossibility and no puncture could be so great as to disable an entire section. A nail would probably penetrate three of the cells. But as these cells are not connected, the air would escape only from those actually punctured. This would reduce the pressure in that section from 80 pounds to 72 pounds, and this reduced pressure would be in but one section or one tenth of the tire. In the running of the car this would not be noticed.

Automobile Census for 1912 in France.—The official figures of the French Automobile Census for 1912 show 76,711 private cars and 12,414 cabs, or in all 89,185 automobiles. The private cars are classed as follows: Cars of 12 horse-power or under, 49,019,of which 33,285 have over two seats and 16,331 one or two seats. The total is 466,117 horse-power for this class, or about 9.3 horse-power per car. Cars of over 12 horse-power are 27,155 in number, including 26,090 with over 2 seats and 1,065 with 1 or 2 seats, the total being for this class 540,168 horse-power or 20 horse-power per automobile. The number of cars of over 2 seats is 59,375, counting all sizes of car, or 67 per cent, while there are 17,396 vehicles with 1 or 2 seats, or 33 per cent of the whole. As regards automobiles, motorcycles and bicycles, the figures are as follows: Automobiles (as above given) 76,711, motorcycles 28,641, bicycles 2,980,985. Calculated according to the last census of population, the number of automobiles, etc., per 1,000 inhabitants is, in round numbers, 2 automobiles, 0.75 motorcycles, and 75 bicycles. Ten years ago the figures showed 0.5 automobile per 1,000, so that the number has since then been quadrupled.

Viaduct at the Osterstrasse.

The Hamburg Elevated and Underground Railway

How Germany's Principal Seaport Has Provided for Local Passenger Traffic

Hamburg, the New York of Germany, has recently acquired possession of a new system of elevated and underground railroad, of which we present a number of views in our accompanying illustration.

The total length of the lines, includes 21,400 feet of subway; fifteen bridges having an aggregated length of 730 feet; iron viaducts measuring 14,000 feet in length; stone viaducts 5,250 feet; earth embankments 37,400 feet. The cars are 42.74 feet long and 8.6 feet wide with a wheel base of 23.4 feet. The wheels have a diameter of 2.64 feet and are driven by direct current electric motors of 800 volts pressure.

The total cost of the Hamburg elevated and underground electric railway was 42,000,000 marks (about $10,000,000) and the power plant has a total normal capacity of 8,000 kilowatts or about 12,000 horse-power as a maximum output.

The main plant, located at Barmsberg, is shown in one of our illustrations, and there are also two substations, located, the one at Heilwigstrasse, the other at the Hamburger Bahnhof.

The new Hamburg elevated and underground electric road is a remarkable piece of engineering and electrical work and represents the latest European progress in electric railway construction in large cities.

The trains are made up entirely of motor cars, each having two 100 horse-power motors, the control being from each of the end cars. The total length of the line is about 16 miles, of standard gage tracks, the distance between stations is 2,650 feet with station platform 200 feet in length.

There is an automatic system of electric lighting used so that the lights come on only when passing through the underground part. Three-phase current at 6,000 volts is supplied by the plant at Barmsbeck, sent to two substations, where it is transformed to 800 volt direct current, and is employed on the third-rail system, the contact shoes working upon the under surface of the rail. The electrical equipment was installed by the Siemens and Halske Aktiengesellschaft and the Allgemiene Elektrizitäts-Gesellschaft of Berlin.

At the Barmsbeck power house of the Hamburger Hochbahn Aktiengesellschaft a most complete electrically operated conveyor system has been installed.

The boiler house is equipped with three boilers of the Steinmüller type, built at Gummersbach, and two of the Borsig type, built at Tegel near Berlin. Each of the water-tube boilers has a heating surface of from 4,000 to 4,200 square feet and supplies normally 19,360 pounds, with a maximum of 26,400 pounds of steam at 15 atmospheres pressure and a temperature of 350 degrees at the superheater which has a heating surface of 1,100 square feet. Two of the steam turbines each have a capacity of 2,000 kilowatts at a speed of 3,000 revolutions per minute, and a third turbine with a capacity of 4,000 kilowatts operates at 1,500 revolutions per minute. The turbodynamos are cooled and generate a current of 6,000 volts directly in the armature windings.

The Central Power Plant.

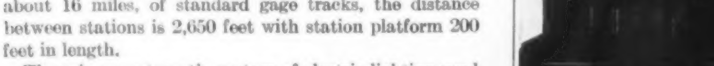
For light and power service about the station, step-down transformers are used with a motor generator set of 40 kilowatts capacity supplying a direct current of 220 volts on the three-wire system, and there is a storage battery provided of 972 ampere-hours capacity. At the sub-station at Keilwigstrasse the current is reduced in pressure from 6,000 volts three phase and converted for railway service by motor generator sets to a direct currency of 800 volts.

An asynchronous three-phase motor of 185 horse-power capacity and of 6,000 volts pressure is directly coupled with two Pirani machines connected with the storage battery regulating plant. This battery consists of 368 cells of 1,258 ampère hours each. There is also provided a signal plant and storage battery of 199 ampère hours with a pressure of 220 volts. One of our illustrations shows the underground electric station Rathausmarkt, while one of the elevated stations of rather remarkable architectural design appears in another of our views.

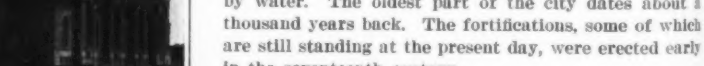
Hamburg has increased almost tenfold in population within the last one hundred years, as shown by the following figures: 1811, 100,192; 1830, 144,383; 1850, 171,013; 1870, 284,492; 1890, 569,260; 1900, 705,738; 1912, 960,000.

The area of the municipal territory is about thirty square miles, of which four square miles are covered by water. The oldest part of the city dates about a thousand years back. The fortifications, some of which are still standing at the present day, were erected early in the seventeenth century.

The first projects for a local railway for Hamburg and its suburbs were made in 1893. Those determined steps in this direction were initiated in 1898 by the Siemens and Halske Aktiengesellschaft and the Allgemeine Elektrizitäts-Gesellschaft, in conjunction with the Hamburg Street Railway Company. As the result of negotiations with the municipal authorities, the contract for the construction of the projected railways was finally given to the two electrical firms mentioned above, in 1906, with the proviso that the city should furnish the requisite funds, and should lease the lines to the electric companies for operation. This is the basis on which the work has been carried out.



The Station at Mundsburg is a Fine Piece of Architecture Designed With Much Originality.



A View Along the Vaults of the Central Station of the Hamburg Subway.

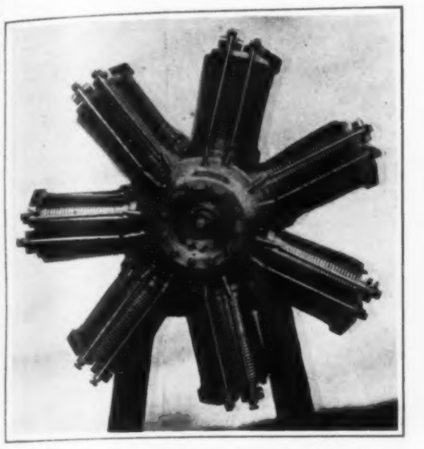


Fig. 1.—The 70 Horse-power Clerget.

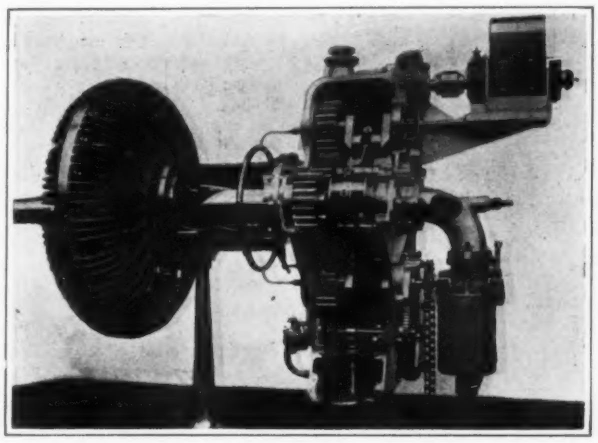


Fig. 2.—The Esselbé Engine With Casing Broken Away.

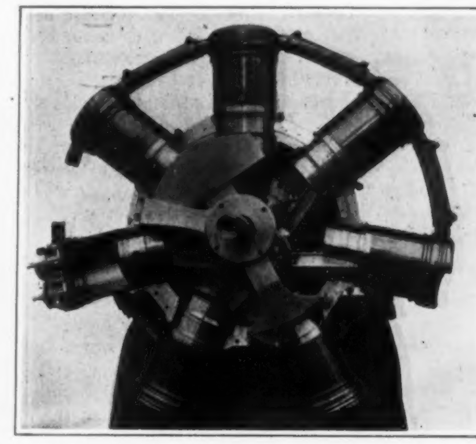


Fig. 3.—View, Partly in Section, of the Salmson Motor.

The Latest Motors at the Paris Aero Show*

Some of the Most Striking Exhibits Described

While the aeroplane remains in much the same position as it was a year ago, except for its much greater structural security, the aviation motor has undoubtedly made headway in the sense that it has been simplified and made more trustworthy. Nevertheless, this most difficult problem is still far from finding a satisfactory solution. The designing of motors of low specific weight has attracted a vast amount of attention, but while many are of very ingenious conception, there are very few that give good results. The difficulties only begin with the building of a new type of engine. Its refinement entails much costly experimental work, and it is only when makers have modified and "tuned up" their engines that some of the motors exhibited in Paris are likely to prove satisfactory. In any event, there are at present plenty of elements for the development of light engines that may be expected to give excellent results in the early future. A year ago there was an impression that engine builders would in the future be less restricted by a question of weight, the idea being that there was really no necessity to cut down weight unduly in aeroplane construction; but since then aeroplane builders have found themselves confronted with difficulties which induce them to attach great importance to a diminution of engine weight. Nor has the theory yet been substantiated that aeroplanes may be fitted with engines of low power. This will no doubt come when machines are designed to give automatic stability, but so long as aeroplane builders keep to the present groove, they will have to rely upon speed for relative security, and for this they are requiring more and more powerful engines.

In view of the difficulties surrounding the construction of aviation motors, it must be admitted that the results obtained have been remarkable.

The Gnome engine has done far better work than could have been expected, and, despite its shortcomings, was for a long time the only practical type of engine. Its chief drawbacks are low efficiency, a huge consumption of castor oil as lubricant and a very short life. On account of its convenience and lightness and the reliability obtained as the result of much patient improvement the Gnome engine is still the leading type of aviation motor, and has given rise to several other engines which differ only in constructional details. The Rhône engine is designed upon the same principle, and has the induction valves actuated mechanically, which is an advantage if it be found possible by this means to throttle down the engine. At present a great drawback to the aviation engine is the difficulty of running it at low speeds. The propeller only begins to produce sufficient tractive effort to move the machine at 600 revolutions per minute, and if engines can be started

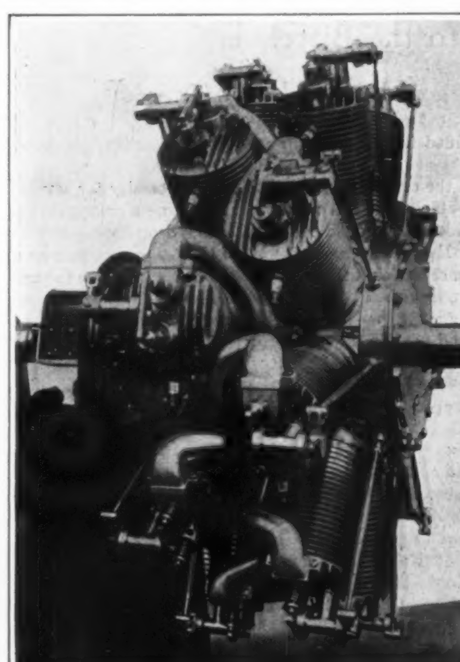


Fig. 4.—The 18-cylinder Rhône Motor.

and maintained at 400 or 500 revolutions per minute, one of the difficulties of aeroplane flying will be overcome. This, however, does not dispose of the importance of being able to test the engine before flight, so that there is an obvious advantage in separating the engine from the propeller. Notwithstanding this drawback, the rotating engine has special merits of its own, notably the small weight per horse-power developed. For example, in the case of the Rhône engine it has been possible, by grouping eighteen cylinders, to develop 160 horse-power with a weight of 170 kilogrammes.

As there can be little variation in the method of rotating cylinders around a fixed center the modifications in the different engines of this type consist principally in simplifying the valve gear. This is the principal feature of the new Clerget rotating engine (Fig. 1). M. Clerget has always identified himself with fixed engines, in which he has obtained remarkable results in the way of weight reduction for power developed, and at the Paris Salon he showed for the first time a rotating engine in which the valve gear is actuated by plates with round teeth placed eccentrically to an internally toothed driving plate of much larger diameter. Another engine of the Gnome type is the Verdet, which differs in no way from its prototype in essential features, but owes any originality it possesses to minor constructional details. The inconvenience of engines of the Gnome type is that the cylinders rotate by the pressure of the pistons on the cylinder walls. This fundamental defect will tell against the engine with rotating cylinders as soon as it can be replaced by some more rational type of motor. These lateral reactions on the cylinders do not exist in the Burlat motor, which is based upon quite a different principle. The engine has four cylinders or multiples of four. The four cylinders are opposed in pairs, thus forming a cross, and each opposed pair of pistons is connected by a rigid rod with a central bearing for the crank shaft, which describes a circle of which the diameter is the radius of the circle described by the crank case carrying the cylinder. The crank shaft consequently turns at double the speed of the cylinders in the same direction. The gases are drawn up through the piston, in the head of which are two induction valves with a special arrangement of springs, whereby they are rendered very sensitive, and are at the same time prevented from being influenced by centrifugal action. The exhaust valves are in the cylinder heads. The weight of the Burlat motor in running order, with engine bed, varies from 4 pounds 5 ounces to 6 pounds 7 ounces per horse-power according to type.

In former years a good deal of interest was centered in engines of the true rotary type, but none of them appear to have met with any success. Of the many that have been brought out from time to time, there was not one at the Paris Salon, but a new rotary motor was shown, known as the Esselbé (Fig. 2), which

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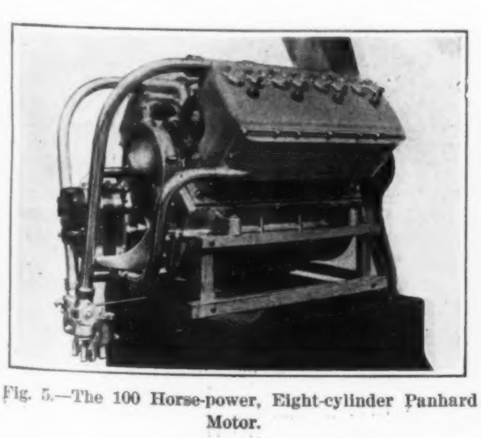


Fig. 5.—The 100 Horse-power, Eight-cylinder Panhard Motor.

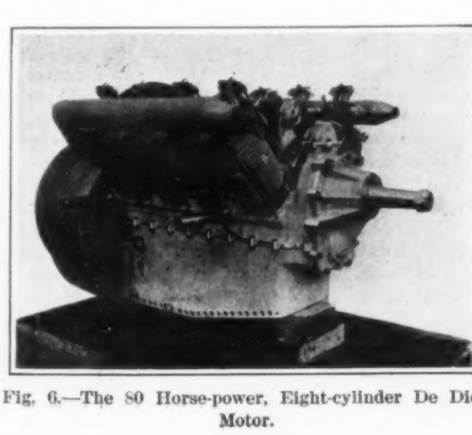


Fig. 6.—The 80 Horse-power, Eight-cylinder De Dion Motor.

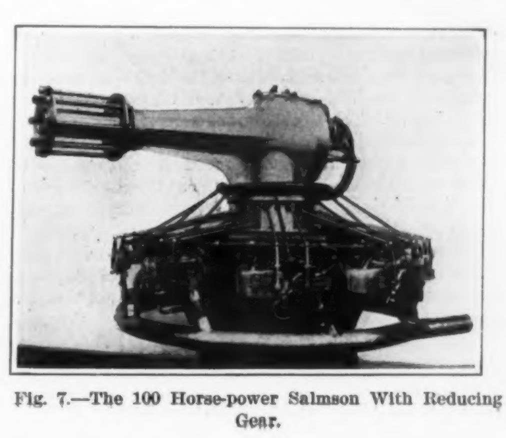


Fig. 7.—The 100 Horse-power Salmson With Reducing Gear.

is ingeniously based upon the reciprocating action of pistons in a circular cylinder. The cylinder body is ribbed and contains four pistons moving in the circular space, each pair of pistons being connected rigidly with a plate on a central tube. The piston-rods form a cross, which closes and opens as the pistons approach or are driven apart. The tubes, to which a partial rotation is given by the pistons, are inside the main tube carrying the cylinder body at one end of the case carrying the rotary motion gear at the other. An elaborate system of lubrication is adopted for this engine. The motor has a bore of 65 millimeters and a stroke of 270 millimeters. Running at 1,200 revolutions per minute, it is said to develop more than 60 horse-power, while the consumption of gasoline is declared to be 225 grammes per horse-power per hour. An entirely different type of engine is the Fatava motor, which aims at giving a variable power by cutting out more cylinders. It is claimed that the pilot can start the engine with one cylinder and take his flight by running the other cylinders, and in the same way, when landing, he can vary the power at will. The engine is built up with a number of cylinders according to the power. Usually there are eight, mounted in pairs on a central crank case in the form of a cross. Each cylinder has an explosion chamber at each end, and two opposed pistons connected rigidly. Midway between the combustion chambers the cylinder has slots through which passes a cross head from which connecting-rods descend to the crank shaft. It is claimed that the 180 horse-power motor weighs only 160 kilogrammes, so that it compares favorably with other aviation motors.

The impossibility of obtaining a high efficiency with rotary engines in which there are considerably lateral pressures on the cylinder walls has had the effect of directing more attention to other types of motors. During the year quite a number of engines, other than the rotary type, have been successfully employed on aeroplanes. Among these is the Salmson with horizontal radiating cylinders and bevel reducing gear to a horizontal shaft carrying the propeller. The engine shown at the Salon had eight cylinders, and was said to develop 300 horse-power at 1,150 revolutions per minute. This is the most powerful aviation engine yet made. It was fitted to two military aeroplanes, one French and the other British. Another motor of the same build, but developing 70 horse-power with 2 cylinders, is shown in one of our illustrations.

The preference being shown at the moment for fixed engines is not only due to the shortcomings of rotary engines, but also to the considerable progress being made by automobile and other firms in the construction of light and reliable engines. Renault led the way with a V-shaped ribbed cylinder engine cooled by a fan in a hood which sent a strong draft right across the cylinders. The propeller was fixed to a cam shaft of suitable diameter for speed reduction. The success of the Renault engine on aeroplanes has induced De Dion-Bouton to bring out an eight-cylinder aviation motor on similar lines. Panhard and Levassor have also entered the field with two monobloc four-cylinder engines arranged V-fashion (Fig. 5). The engine is water cooled, and the side plate is ribbed to keep down the temperature of the water. The propeller shaft is geared down from the crank shaft. The engine develops 100 horse-power, and its weight is 200 kilogrammes.

There is a notable difference in the construction of aviation engines by automobile firms, and by those who make a speciality of aeroplane engines. In the one case, the practice of car engine construction is closely followed and a reduction of weight is obtained by the employment of high resistance steels, without any attempt being made to diminish unduly the margin of safety; in the case of special aviation motors, weight cutting is often carried out everywhere, with extremely thin steel cylinders, to which are fitted thin copper water-jacket casings, and the valve gearings, tappets and other parts would be absurdly weak if it were not for the employment of special steels. These engines are naturally very expensive, and there has not yet been sufficient experience of their use to offer proof as to their durability. It is impossible, at the moment, even to suggest what is likely to become a settled type of aviation motor.

The idea that the human motor can be employed for flying is still entertained by crowds of inventors, who have been encouraged by the prizes offered to those who can simply lift themselves from the ground. The collection of machines in the section devoted to "aviettes" provided remarkable examples of misplaced ingenuity. It is hopeless to expect to do anything by fitting planes to bicycles. It is only when some more rational method of flight is discovered that any great and rapid progress will be made. At present, progress has stopped at the military aeroplane.

Drop Forging*

Its Relation to the Bicycle and Automobile Industries

By Frank W. Trabold

HISTORICAL.

A GENERAL outline of the methods used in, as well as of the history of the process of die-blacksmithing, or drop-forging, seems warranted. The English claim the art originated in the manufacture of the Enfield rifle about 1850, the then standard English infantry equipment. Those loyal to American ingenuity and development claim the origin of the process to have been with the Colt Fire Arms Company at about the same time. Germany lays claim to the conception and development of the art by seemingly authoritative prints and documents antedating both the English Enfield and American Colt claims.

In the commercial development in the period mentioned cost conditions in production were considered more seriously than theretofore. Through the consequent desire to eliminate excessive costs in mechanical appliances methods were sought to accomplish more economical production. The demand for interchanging parts also had its influence. So far as any one particular class of work having been more largely than others instrumental in this advance is concerned, the making of firearms seems to hold an unquestioned position as pioneer. Even to-day it keeps a fair proportion of the forging equipment of the country steadily occupied. The drop-forging process applicable to the making of parts covering a most varied assortment of industries, such as the manufacture of firearms, sewing machines, cutlery, agricultural machinery, parts for ordnance of heavy and light types, tools for many purposes, locomotives, engines of practically all types, etc. (in fact, in all places where high-efficiency steel parts are required) has, during the past 15 or 18 years, been through two booms, each created by an individual and distinctive line, which kept all the available forging equipment busy to its utmost capacity.

THE BICYCLE INDUSTRY.

The first was the requirements of the bicycle, the necessity of combining minimum weight and maximum strength finding its answer in forged steel parts. The accuracy required to minimize the finishing labor by hand and machine operations called for die-forging or drop-forging. The bicycle business, as most of us know, took a decided turn owing to the sport being generally abandoned within a season, practically. But right on its heels came the development of the automobile, many of the bicycle manufacturers, by reason of large installations of equipment peculiarly adapted to a large extent to automobile manufacture, undertaking automobile design and construction. The failure of one industry was an important factor in advancing another; not that the automobile would have remained undeveloped, the rapid collapse of the bicycle enterprise making, however, immediately available the efforts of many men specially qualified for the important work of the new industry.

THE AUTOMOBILE.

In the case of the automobile the necessity for several high-efficiency steel parts for the engine alone placed a considerable quantity of work in the drop-forging industry. Ever since the beginning of the building of cars on a commercial basis the tendency each year has been toward the adoption of more drop-forged parts. The drop-forging art, even though a comparatively new one, seemed unchanged for a long period prior to the advent of the motor car. It had progressed to what was considered a high state of efficiency, but the development during the past 10 or 15 years has been remarkable. The making of longer dies than had been used generally before is an item of no little account. Formerly a die for a part as long as, or involving as much work as, a four-cylinder crankshaft caused a shudder. Now a six-cylinder crankshaft is common. Axle dies which at first were considered simply out of the question as beyond the possibilities of the process now cause no comment. In this development of proportions the automobile cannot be given exclusive credit, although it assisted materially. The greatest development in the manufacture of drop-forging for which the automobile alone has been the cause, is the handling of high-efficiency steels, mainly of new alloy combinations. By progress in the art of special heat treatments and quenchings (peculiar in many respects), physical properties undreamed of prior to the advent of the automobile have been attained. The commercial stability and success of the car demanded something better than had existed.

DIE-MAKING.

Intricate parts are now formed with peculiar bends and twists in "locked" dies. The term "locked," to some extent a misnomer, covers in general all dies the faces of which are not in one plane. Some locks are simply plain bends or swerves, while others are really complicated, such as a die for forming a steering-arm with the two branches having at their extremes bosses neither of which is in the same elevation with the shank fitting to the knuckle, and with curves provided to care for clearances. Much work which formerly was produced in flat dies and subsequently bent to ultimate shape by hand on "formers" or in a supplemental set of tools in hammers, is now done in locked dies.

DRAFT.

Few not closely associated with drop-forging appreciate the necessity for clearances, technically called "draft." This is essential and to produce forgings commercially in a clean condition the minimum is 70 degrees This. as a general practice, is provided on all surfaces directly perpendicular to the plane of the dies. While forgings can be produced with less than this degree of draft the absence of a good clearance means rapid deterioration of the lines and draft surfaces, causing cracks or fissures called checks and leaving sharp fins or slivers on the forging, not only defacing the appearance but causing trouble and annoyance in jig and fixture fitting. It is poor economy to attempt to decrease machining expense by the reduction of draft and encounter annoyance in labor and time and consequent inaccuracy in machining caused by the checks. Absence of adequate draft also places an extremely high maintenance charge on dies. This is taken into consideration when figuring estimates and making prices. It also involves a grave danger so far as service possibilities are concerned, in that if carried into deep impressions it does not allow for enough surface distribution of the strain and breakage of dies is more likely to follow, the time necessary for replacement being often expensive to consumers.

AUXILIARY DIES.

In figuring, if for approximation only, consideration should be given to the necessity of trimming dies and punch. Usually when die charges are questioned it develops that no consideration whatever has been given to the making of the dies to remove the flash or surplus, or to the possible necessity of auxiliary dies for preliminary operations of rough forming, called breaking-down dies which, in the case of intricate shapes, are often required.

SKILL REQUIRED IN DIE CONSTRUCTION.

The principal skill in die construction is not in the finishing impression, which is a matter of nice work, patience and special care for accuracy. Taste can be displayed in formations of intersections and finish of surfaces. But the design and formation of the edging and "breakdown" impressions require a knowledge of the work beyond that possessed by the most skilful general mechanic who is not experienced in this special line. Intimate knowledge of, and experience in, the work alone qualify one for the layout of this portion of the dies. Should the rough stock be pinched or "broken" too short, laps or "cold-shuts" are likely to occur; should too much stock be left after edging or breaking down, the work to reduce to the finished forging may be considerably greater than necessary. There is a point that represents just the right condition in which to have the stock formed prior to the finishing impression; the greater the skill the more nearly is this point approached. Cost conditions are thus influenced.

ACCURACY.

The accuracy possible in die-forging by drop-hammers is seldom realized. While it is preferable and commercially necessary to have a tolerance of approximately 1/32 inch in thickness, it is possible by careful forging and supplemental re-striking operations, to come within a few thousandths from a given dimension.

GUTTERING.

The "guttering" of dies, that is the provision made for the overflow of metal, is an important factor in securing accuracy so far as thickness is concerned. Closely adjacent to the outline of the part, the dies are guttered or

* Paper read before Metropolitan Section of the Society of Automobile Engineers, and published in its *Bulletin*.

grooved, thus providing a space for the heavier portion of the flash and permitting the two halves of the blocks to come together more closely.

ROUGHING.

There is considerable variation in practice in different shops. To us the "breakdown" impression is known as the roughing impression, whereas in some shops the "edging" is called breaking down. For many parts, where the runs are not large, dies are made for but the edging and finishing impressions. Where the quantity to be produced is large, it is without doubt advantageous to have a "breaking-down" impression as it forms the stock roughly and relieves the finishing impression of much work, and sharp lines and uniform surfaces are preserved in the produced parts. On the other hand, should the entire work from the edging be performed by finishing impression, more rapid wear occurs and the accuracy of all dimensions is not maintained for nearly so great a number of finished parts. It is somewhat analogous to roughing in machine work, using the finer tools for the lighter finishing cuts.

MULTIPLE DIES.

It is still necessary with many parts, although, due to development to a much less degree than formerly, to make two or more sets of dies requiring an individual hammer for each set; one set, where multiple dies are used, usually being made for "breaking down," and another for finishing. However, the work is now most commonly done completely in one set designed to care for, on different portions of the blocks, the various operations, thus conserving heat and reducing cost figures.

AMOUNT OF STOCK.

The amount of stock necessary to make a forging is seldom appreciated. It varies materially, depending on the character of work, and is a fairly definitely fixed item. Experience permits estimating very closely the amount of stock required to produce a forging of a given weight. The wastage is called "shrinkage." As examples of what the shrinkage is, approximately: In valve stems it is about 25 per cent; in crankshafts it is about 50 per cent; and in connecting-rods (where a most varying condition exists) it is 150 per cent or more.

Usually to one unfamiliar with the process it is not apparent that for making a forging weighing 5 pounds possibly 10 or 12 pounds of stock are necessary. Labor, tools and equipment must be employed in removing the surplus. About 2 per cent of the shrinkage is lost in oxidization, by scale formation and gaseous consumption.

METHODS OF TRIMMING.

Practices as to the removal of the flash or surplus metal vary considerably in different establishments although they are being brought gradually to a more uniform condition, largely through the influence of cost conditions. Each year the tendency is toward the trimming of larger pieces cold, whereas only a few years ago hot-trimmed was considered necessary with comparatively small parts. Many jobs, at one time beyond the forging capacity of most plants, are now cold-trimmed. The cost comparison in hot and cold-trimming is approximately four to one, to say nothing of the handicapping of forging production with expensive equipment, fire charges and higher wage rates. The curtailment of product in hot trimming is, under busy conditions, a serious consideration.

MOTOR CAR STEELS.

The care required to forge properly the high-efficiency steels which are sensitive in character has brought drop-forging considerably beyond where it was several years ago, so far as proper heats are concerned—regulating of forging, quenching and drawing temperatures, etc. The work has become more a science than pound-production of so much shape. Years ago what forgings were not tool steel were pretty much mild machine steel, 0.10 to 0.15 carbon, of Bessemer quality, with a few variations of somewhat higher carbon open hearth steels for pedal-crank work, etc., and open hearth steels of approximately 0.40 to 0.60 carbon when a low grade of tool steel was wanted. The automobile requirement of the purer open hearth steels has almost eliminated the use of Bessemer steel in drop-forging work, excepting to a limited extent in parts where free-machining qualities are necessary, especially where threads are to be cut. We all know the consideration now given chemical composition.

CONTINUOUS CRANKSHAFT FIBER.

One of the marked advantages of the drop-forging over the cruder hand-forging, on which much stock is often left to be machined, is that in the former the original fibrous structure of the rolled bar is preserved and intensified. This can be appreciated especially in a crankshaft, the fibrous structure being continuous throughout the entire shaft, including the arms and wristpins. In hand steam-hammer forgings which have the slabs left solid and the crank-pins and arms formed by machining from the slabs, short cross-grains result sacrificing a certain amount of physical property, not noticeable, of course, in a test-piece cut from the shaft ends but unquestionably affecting the part as a whole. A crankshaft etched to remove from its surface all traces of the constituents of the steel other than the pure iron, will illustrate the point.

BLOW HOLES.

Many pieces made by drop-forging are not designed for manufacture by this process on account of their needs, and by reason of castings not having sufficient strength in the proportions allowed provided the castings were sound, but by reason of the fact that the working of wrought steel by this process insures automatically absolute freedom from blow holes which are, of course, hazardous, and have not, to my knowledge, been overcome entirely in any cast product. Insurance in this respect is considered well worth the higher cost of the drop-forged product.

DECARBONIZATION.

Decarbonization of surfaces of annealed parts is worthy of thought. In parts for automobiles it is not such an important item as in tool work, where, through the necessity of annealing the parts in order to trim the surplus metal or flash from the forgings and to permit subsequent machining, decarbonization occurs on the surface. Care should be taken with all parts to be made from tool steel or any high carbon steels which are to be tempered for surface service, to have sufficient material allowed for cleaning off in the machine operations the decarbonized surfaces. Otherwise good hardening effects cannot be secured, as this surface after the annealing operation becomes spongy by reason of the carbon and other constituents giving the proper hardening effect being consumed.

RECARBONIZING.

Of course, where necessary, this decarbonizing surface can be recharged with carbon by packing the same in cast iron or steel boxes, the parts being surrounded with a substantial jacket of bone, leather, charcoal or some other carbon-containing mixture, and brought up to a temperature of about 1,500 deg. Fahr. The depth of carbon penetration, as in the case of ordinary case-hardening of milder steels, is controlled by the time of soaking in the furnace. For example, a 1/64-inch penetration requires heating at the temperature mentioned about three hours. Greater time in proportion is necessary for additional penetration.

PICKLING.

To facilitate machining work, and to remove the scale or oxidized surface from the forgings, which, on account of its glassy and hard condition, is most injurious to drills, milling cutters, and cutting tools generally, the forgings, before shipment, are pickled. For this a sulphuric acid solution is generally used, in the proportion of one part acid to about twenty parts water; heated with steam jet. Nitric and muriatic acids are also used in solution. Plain wood tubs or with lead lining, or concrete tanks are used.

HAMMERS.

Practice varies in selecting the class of hammer to produce similar results. Steam hammers are largely used, entirely in some shops; board hammers in others. I recommend the use of both; the board hammers entirely by reason of their lower initial expense and lower cost of maintenance up to a weight of about 1,500 pounds, beyond this selecting the work for each class, the steam hammers to be used largely where a sufficiently substantial body is in the piece to be made to afford ample cushion for the greater severity of the blow. Rupture of the structure is less likely with lighter hammers and although more blows are required, a more even condensation results. A greater amount of working, within reason, on forgings at proper heats is good practice.

AUXILIARY MACHINES.

Of course, auxiliary machines of various kinds are used in the different shops, such as trip hammers, hydraulic presses, upsetting and heading machines, bull-dozers, swaging and drawing machines of special construction and rolls. Their uses are very generally understood.

DROP-FORGING METALS OTHER THAN STEEL.

The drop-forging of iron, copper, bronzes of varying mixtures, aluminium and high-speed steels is daily practiced. These metals have not, however, thus far entered to any appreciable extent into the drop-forged parts of automobiles.

Radium and Earth History*

By G. W. Bulman

It would appear that radium has landed geologists and biologists in a difficulty greater than that from which it was hoped it would deliver them. There is radium in the earth, and radium in disintegrating gives out heat. Therefore a once molten globe will cool down more slowly than if it contained no such independent source of heat. Lord Kelvin's calculations were made on the supposition that there was no source of heat except what the earth possessed as a molten globe. Hence we are at liberty to extend the time that has elapsed since the earth became the possible theater of geological change to 500,000,000, 1,000,000,000, or even more, years ago. Radium has given us a blank cheque on the bank of time.

So far so good. But when the actual calculations were made as to how much the radium known to exist in the outer shell of the earth would effect its cooling, this was found to be too great. It would, in fact, *raise* the temperature of the earth the fraction of a degree annually.

Two suggestions in the way of explaining the difficulty have been made by Prof. Joly in his "Radioactivity and Geology." We do not think that either will bear the test of careful examination.

It is only the outer shell of the earth that can be examined for radium, and though there appears to be no diminution with depth, there may be less, or none, in the lower parts. If, then, we have to spread the heating effects of the radium of the outer shell over the whole earth, it will obviously be insufficient to raise its temperature. The only possible result of its disintegration will be a retardation of its cooling to an indefinite extent, which is what is wanted. This is the first suggestion.

The second, admitting that the proportion of radium in the interior may be the same as at the surface, avails itself of the fact that vast masses of the central earth may be thermally isolated for immense periods of time. The rise in temperature of such parts—due to their radium—need not, then, affect the rocky crust. In the course of prolonged ages, however, such internal reservoirs of heat might, so to speak, overflow. Great rushes of heat might reduce the outer shell to a molten state, and inaugurate a new geological era. To quote Prof. Joly:

"With an interest almost amounting to anxiety, geologists will watch the development of researches which may result in timing the strata and the phases of evolutionary advance; and may even—going still further back—give us reason to see in the discrepancy between denudation and radio-active methods, glimpses of past æons, beyond that day of regeneration which at once ushered in our era of life, and, for all that went before, was 'a sleep and a forgetting.'"

But let us look at these interesting suggestions a little more closely. If the radium contents of the outer shell were spent in heating the whole earth—or any considerable portion of it beyond the shell containing it—then we might suppose it just sufficient to retard its cooling indefinitely. But as the temperature of the earth increases with depth, we cannot suppose that any of the radium-generated heat of the outer shell passes downwards. It must *all* be spent in heating its *own mass*. Therefore, according to calculation, this outer shell should be rising in temperature. There seems to be no escape from this conclusion. And this applies also—and even more forcibly—to the second explanation. For with an interior rising in temperature it is still more difficult to imagine any of the radium-generated heat of the outer shell passing downwards. The radium heat of the crust must all be spent on itself.

Even this does not express the full extent of the difficulty. The theory of the radio-active elements is that they have their periods in which they lose half their substance. The period of radium is 1,760 years, and that of uranium 5,000,000,000 years. Now, since we know of no source whereby the supply of uranium in the earth is replenished, we must suppose that there was twice as much uranium five thousand million years ago as there is to-day. And whatever length of time we go back we must suppose there was more uranium, and hence a greater heating effect, than there is to-day. A molten globe could not *begin* to cool until the radium contents of its outer shell were *less* than that of the earth to-day.

The moon presents another difficulty. Our satellite is generally held to be a bit of the earth thrown off some fifty-six million years ago. It was then molten, and the drag of the tides produced in its molten mass by the earth gradually reduced its rate of rotation. Now it only turns on its axis in the course of a revolution round the earth. The moon's radium has not prevented it reaching a stage of cooling far beyond that of the earth. And yet the moon may be supposed to have had the full proportion of radium known to exist in the outer shell of the earth. Yet it has cooled down from a molten state in fifty-six million years in spite of its radium! And it would appear that the earth has done the same, although it has not reached the same stage. For if the moon was molten when it began its separate existence, so must the earth—which gave it birth—have been.

And it would appear that there must be *more* radium in the sun than in the earth. For helium, the product of the disintegration of radium, was discovered spectroscopically in the sun years before it was known on earth. It must surely, therefore, exist there in much larger quantities. Hence the sun should be getting hotter at a greater rate than the earth.

The difficulties introduced by radium into earth history are greater than that which it was hoped it would remove.

* From the correspondence column of *Nature*.

The Auto-Truck for Coal Delivery

From Railway Car to Consumer

By Frank C. Perkins

Fig. 1.—Side Dumping Steam-driven Coal Trucks.

It is well understood that methods of transportation have been revolutionized during the past few years by the inventions and improvements that have taken place, but until very recently these betterments were confined to the big transportation factors—shipping and railroading.

As soon as the coal for instance had been transported from the producer to the distributor with speed and economy via the great rail or water routes, the distributor would complete the journey of fuel sending it to the consumer—by a method as old as commerce itself, which has not become any better or worse than it had always been—the horse and wagon method.

It is only a few years since any other means could have been employed. The draught horse kept his position as a transportation factor because there was nothing better to replace him.

Necessity produced the motor trucks shown in our engravings, and now retail coal companies may have a delivery equipment that can give far more efficient service than horse-drawn trucks. For, in the cities at least, profit in these lines of business, is largely a matter of transportation. Motor trucks are several times speedier than horse trucks and will permit much quicker service to be given to consumers.

Our illustrations show several different types of coal delivery wagons.

Two types of English steam-driven end-dumping coal trucks are noted in Figs. 4 and 5 while Fig. 1 shows another steam truck, dumping at the side, designed and constructed at Leeds, England. One of the latest and most thoroughly up-to-date American coal handling motor trucks is that shown in illustrations Figs. 2 and 3. This is designed for dumping the coal at the side or at the end, power being supplied for this operation by the gasoline engine which drives the truck. The photograph Fig. 2 shows the truck in the act of dumping a load of coal from the side, the entire side of the body opening up in discharging the coal, a small gate also being provided in the side and end for emptying the coal into a man hole.

This heavy service dump truck has a power-driven dumping device that will greatly simplify the haulage problem. The hauling of such materials as coal, earth, crushed stone, common bricks, cement, sand, gravel, slag cinders and prepared road material is work which motor trucks can perform with remarkable efficiency and economy.

In order to give maximum results, however, a motor truck used for hauling these materials should be equipped with a properly designed dump body. Owing to its great simplicity the power-driven dumping mechanism in the heavy service dump truck illustrated is not at all liable to get out of order, and the parts composing it are so few and of such size that the liability to breakage is practically eliminated.

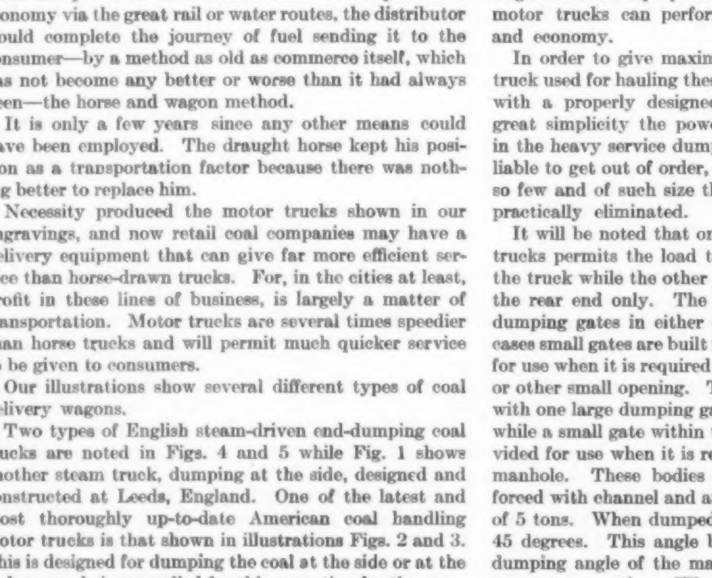
It will be noted that one of these heavy service dump trucks permits the load to be dumped at either side of the truck while the other is made with dumping gates in the rear end only. The side dump is built with large dumping gates in either side of the body and in some cases small gates are built in the center of the larger gates for use when it is required to deliver the load into a chute or other small opening. The end dumping truck is built with one large dumping gate in the rear end of the body, while a small gate within the larger one may also be provided for use when it is required to deliver the load to a manhole. These bodies are built of sheet steel reinforced with channel and angle iron, and are of a capacity of 5 tons. When dumped, the body tilts to an angle of 45 degrees. This angle being greater than the natural dumping angle of the material carried, insures a clean, prompt evacuation. When the power dumping mechanism is in action an automatic trip arrests the action of the dump screw when a tilt of 45 degrees has been reached. In a similar way the action of the dump screw is automatically arrested when returning the body to its normal position. The body may also be tilted to any intermediate angle within 45 degrees and held in that position while the truck is in motion, making it possible to spread the load while dumping, if desired. Both side and end dump bodies are operated by a dumping mechanism of the same kind.

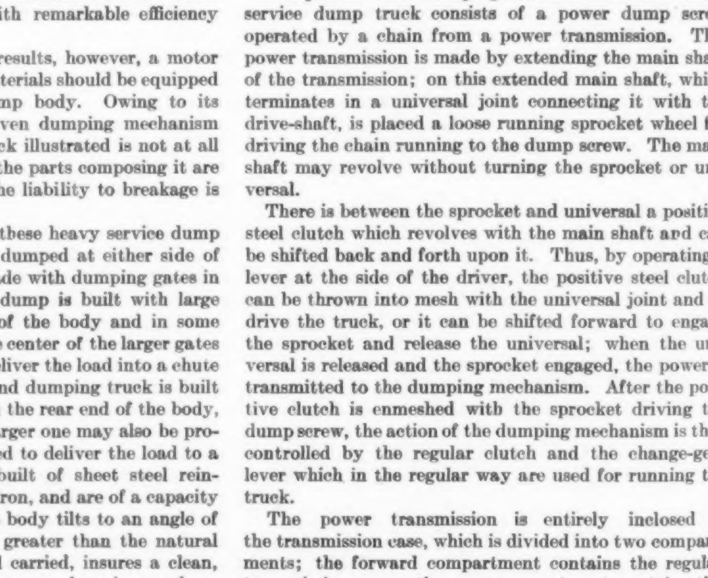
The power-driven dumping mechanism on this heavy service dump truck consists of a power dump screw operated by a chain from a power transmission. This power transmission is made by extending the main shaft of the transmission; on this extended main shaft, which terminates in a universal joint connecting it with the drive-shaft, is placed a loose running sprocket wheel for driving the chain running to the dump screw. The main shaft may revolve without turning the sprocket or universal.

There is between the sprocket and universal a positive steel clutch which revolves with the main shaft and can be shifted back and forth upon it. Thus, by operating a lever at the side of the driver, the positive steel clutch can be thrown into mesh with the universal joint and so drive the truck, or it can be shifted forward to engage the sprocket and release the universal; when the universal is released and the sprocket engaged, the power is transmitted to the dumping mechanism. After the positive clutch is enmeshed with the sprocket driving the dump screw, the action of the dumping mechanism is then controlled by the regular clutch and the change-gear lever which in the regular way are used for running the truck.

The power transmission is entirely inclosed in the transmission case, which is divided into two compartments; the forward compartment contains the regular transmission gears, the rear compartment contains the sprocket, clutch and universal.

Recently a five-ton dump truck of this type was delivering coal to a business block located one mile from the





Figs. 2 and 3.—These Types Are Well Adapted for Heavy Service, as They Dump Quickly and Thoroughly.

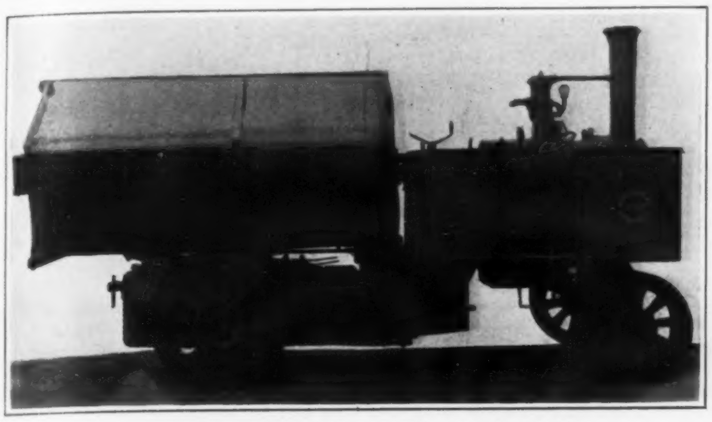


Fig. 4.—End-dumping Coal Truck of English Make.

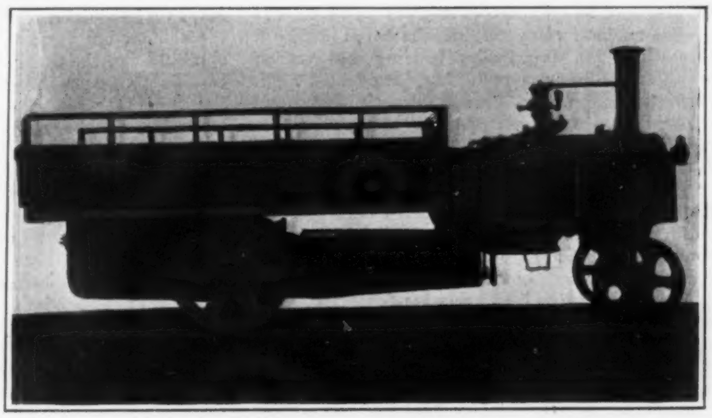


Fig. 5.—A Seven-ton Steam-propelled Coal Truck.

yards, making a round trip distance of two miles—the length of the working day was 10 hours. The truck was loaded at the yards from a clam-shell loading device in from 4 to 10 minutes and the road time for the round trip averaged 20 minutes. This is a slow rate of speed, being only six miles per hour, owing to the fact that the delivery was made over a steep grade and through badly congested streets. The average load carried was 11,240 pounds of slack, and the average trip with loading and unloading consumed 40 minutes. Fifteen trips were made during the day and a total of over 84 tons was delivered to the customer's bins.

Comparing this work of the motor truck with the work of a horse-drawn truck on the same day and on the same job, one team of horses made 8 trips during the 10-hour day and, with a modern dump wagon, carried an average load of 7,300 pounds and a total tonnage for the day of 29 tons against the 15 trips per day made by the motor truck carrying an average load of 11,240 pounds and a total tonnage for the day of 84 tons. It is necessary for the company to keep a number of snatch teams on the hill near their yards to assist all horse-drawn trucks in making the grade. The dump truck takes this hill on low speed with ease. It is estimated that the use of these snatch teams adds 2½ cents per ton to the cost of cartage. These figures show that even on short hauls against adverse conditions, a 5-ton dump truck is doing the work of three horse-drawn trucks and saving the extra service of snatch teams on the hill, which are required by the horse-drawn trucks.

Recent Development of the Locomotive—II*

The Latest Stages in Its Evolution

By George R. Henderson

Continued from Scientific American Supplement No. 1931, page 9, January 4, 1913

ADJUNCTS AND DETAILS.

It is probably true that cast steel is more closely connected with the development of the large locomotive than any other single item entering into locomotive construction, and the possibility of being able to get large castings in this material has proved a very important factor in the advancement of this proposition. Some years ago steel castings were produced only in very small sizes by means of crucible furnaces, and such things as steel driving wheels, frames, foot-plates, etc., were unknown. With the large number of open-hearth steel plants making steel castings of high-grade material now in this country, there has been a great impetus given to the reduction of weight and increase of strength by substituting steel castings for iron castings and, in many cases, for iron forgings. In the former category probably driving wheel centers have been the most conspicuous examples, as even ten or fifteen years ago the axles and crankpins of locomotives were assuming such proportions that it made it difficult to obtain the proper strength with an iron casting. As the main driving wheel is subjected to a far greater stress than the other driving wheels, steel was first substituted in the main driving wheel only, but nowadays, when it is desirable to get the boiler as large as possible and thereby keep the other parts as light as possible, cast steel is used in many cases in all the wheels of a locomotive. It has now even become difficult to get along with cast steel, as, with the increased size of axles and pins and the inadvisability of increasing the stroke, we have gotten to such a point where there remains only 5 inches or 6 inches of metal between the axle and the pin fits, and when we consider that these are forced in with pressures from 100 to 200 tons it will be understood how difficult it is to produce a steel casting that will satisfactorily withstand forcing stresses and also those due to operation.

At first there was much difficulty in making driving wheels, as the rim would set in the mold long before the hub and fractured spokes would occur. This was overcome by separating the rim into sections so that the spokes could pull the rim toward the center as cooling progressed. Later, however, the steel works found that they could cast these rims solid by uncovering the hub and arranging to cool that portion more rapidly so as to promote uniform contraction throughout the casting.

Foot-plates have been another very important example of the use of steel instead of iron castings. In olden times the foot-plate was often made unusually massive in order to add adhesive weight to the engine, but the great desire to produce boilers of maximum capacity has led to the use of foot-plates of cast steel, thereby reducing the weight very materially and allowing for greater boiler capacity. In such castings as these the weight of the piece in steel would be anywhere from one half to one third of what it would be in cast iron, and when this practice is followed through the different parts of the engine the great saving of weight is at once apparent.

Boiler supports, guide yokes, frame separators, and in the Mallet type of locomotive, saddles connecting the frames and the cylinders, are now made of steel castings, and this metal is very much superior to iron in standing impact and even the effects of an unexpected collision.

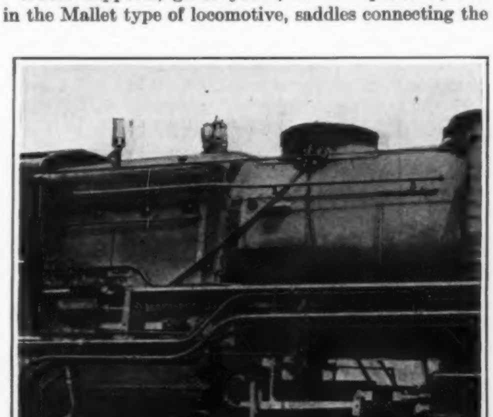


Fig. 7.—Power Reverse Gear.

In the replacement of forgings, cast steel has also rendered an important service; the most notable example of this is in locomotive frames. For years these were made of iron worked under the steam hammer, and, as the frames were of large sections, it was very difficult to properly weld the pedestals and braces together. When the sections were not over 4 inches in thickness there was little difficulty, but even then it was found that the welds, in spite of the best care, had often been imperfectly formed and would in service pull apart. With 5-inch frames, which are now common, and 6-inch frames, which are being introduced, this work would be very difficult, but cast steel permits the use of a section of almost any size. Then, too, the braces and all the parts are cast in one solid piece, so that there is less fitting and less opportunity for parts to become loose and work upon each other when the engine is in operation. Many of the more complicated forgings, such as equalizer beams, frame braces, and parts that have been made in the blacksmith shop, are now constructed of cast steel, often reducing the weight and at the same time the cost of manufacture.

In this country open-hearth steel is used almost exclusively for this material, but in Europe Bessemer steel with a comparatively high phosphorus content is much in vogue. This makes a smoother casting, as the phosphorus adds to the fluidity of the metal when being poured, but Americans are rather opposed to the use of Bessemer steel in important structures on account of its known liability to segregation and to crack under sudden strains. The open-hearth steel used for locomotive castings is both acid and basic, the former, of course, requiring a higher grade of pig to be used in its production. The great difficulty with steel castings at the present time is the tendency for piping and blow-holes to diminish the strength of a section at some part where it is impossible of detection before rupture, and, while this difficulty is being gradually reduced, largely by the careful study of proper design and the introduction of large sinking heads in molding, yet it must still be contended with and prevents us from using as high a fiber stress as we should if we could get rid of these objectionable features. Such steel has a tensile strength of from 60,000 to 80,000 pounds, which is fully double what can be obtained from cast iron, and, on account of its ductility and resistance to stand blows, it is superior to cast iron in even greater proportions than its increase in strength.

As yet little has been done in the use of cast steel cylinders in locomotives, although some few have been in service. As there is a tendency toward three-part cylinders—that is, a central saddle with a separate cylinder bolted at each side—the feasibility of using steel cylinders has been greatly enhanced. Of course, such cylinders have bushings of cast iron for both the piston and the valve, and, as the latter is nearly always of the piston type, the construction of a cylinder of cast steel is not especially difficult. The recent practice of using outside steam pipes materially assists in this problem.

Following the introduction of steel castings for frames, driving wheels, driving boxes, etc., alloy steel has also made its appearance in locomotive construction, and chrome vanadium or chrome titanium is frequently possible for the parts involving heavy stresses. The latter adds very little to the cost of steel per ton, and is thought by some to be practically as efficient as the high-priced vanadium steel. Nevertheless, there is difficulty being experienced, with both of these alloys, and when we consider that even the heaviest sections that we are able to produce now are hardly strong enough to stand such enormous piston loads, which in some cases reach to 140,000 or 150,000 pounds, the necessity for refinement in this line is apparent.

There has been little attempt to make such parts as connecting rods, parallel rods, etc., of steel castings, and the few attempts that have been made in this line have not been crowned with sufficient success to warrant extension in these particular details. Crank axles are seldom used in this country, but it has been found that the

*Paper read before the Franklin Institute and published in its Journal.

crank-webs in a built-up axle have given very good service when made of cast steel, but the forces in such a structure produce, principally, bending and torsion where steel castings are particularly satisfactory. In connecting rods, however, there is so much tension and compression that it does not seem wise to run the risk of using a metal that may have a blow-hole or pipe at some critical part, and only high-grade hammered steel is used, as a rule, in these forgings.

While the Walschaerts valve motion has been recognized for many years as a suitable means for operating the valves on a locomotive, and has been used largely in Europe, it is only recently that its application to locomotives in this country has been worked out on a large scale. There have been many essays written upon the relative advantages of the Stephenson, which has been universally used, and the Walschaerts valve motion, so far as the movement of the valve itself is concerned, some claiming the Walschaerts gear with its constant lead was a great benefit, while others claim that the Stephenson motion with its increasing lead of early cut-offs is most desirable. Personally, we are inclined to agree with the latter theory. It is well known that a locomotive with a large amount of lead is very slow in starting, whereas one with a small or blind lead will be particularly active in getting under way and being reversed. With the constant lead of the Walschaerts motion it is necessary to settle upon some amount that will be satisfactory under ordinary running conditions, and this often produces a locomotive that is noticeably tardy in handling. In the Stephenson motion it is perfectly feasible, if desired, to set the valves line and line when the reverse lever is in the corner and have from ¼ inch to ⅜ inches lead when working at early cut-offs. This in itself constitutes a considerable advantage, however, it has been found by practical demonstration in road tests that there is no essential difference in either fuel economy or economy of train operation between the two methods of distribution, and for all practical purposes we can generally assume that the steam distribution and economy will be the same in both.

What, then, has given the impetus to the Walschaerts gear within the last decade, if there is no advantage to the valve movement, and, in fact, the possibility of a disadvantage? The answer is that it is simply caused by structural reasons. The Stephenson motion, with its inside links, while being well protected from damage by a side-swipe, has the disadvantage of requiring eccentrics, which, with the modern proportions of driving axles, have assumed very large dimensions, so large, in fact, that there is continual trouble in trying to keep them lubricated, as the weight and speed of the running surfaces have been increased with the enlargement of the axles. There is also considerable difficulty in suspending the link centrally, and, while it could be done, it was rather a troublesome and expensive arrangement. Perhaps the greatest incentive to remove the valve motion from under the barrel of the boiler was the fact that the heavy engines with long frames require cross-bracing, and when the eccentrics and rods are removed we have splendid opportunities for connecting together the frames with ample cross-braces. The increased weights have called for wider frames and long journals, so that there is very little space left in which to place a satisfactory inside link motion.

The Walschaerts gear overcomes both of these difficulties permitting not only a very comprehensive system of cross-bracing, if desired, but also eliminates the eccentrics and places the motion where it is very accessible. It has been claimed that the Walschaerts valve gear has fewer pieces and weighs less than the Stephenson, but when we consider the supports necessary to carry and suspend the various parts of the Walschaerts gear there is a great deal of weight and expense which, while it is not a part directly of the valve gear, yet is necessary to support the same. This results in an increased cost for the Walschaerts as compared with the Stephenson valve gear. In many cases these supports can be worked in as part of or an extension of the cross-bracing of the frames and boiler and produce a very simple and strong structure, and, taking everything into consideration, the change in valve gear has resulted in a very much better braced engine than was possible with the old Stephenson motion. There is no question, therefore, but that this valve motion is here to stay, in spite of the fact that many people consider the actual movement of the valve not as satisfactory as with the Stephenson arrangement.

With the large and heavy valves that must be moved in the modern locomotive the force necessary to operate the reverse lever has considerably increased. With articulated locomotives, which have two or more shifting valve motions, the work to be done is doubled or trebled; therefore, we are prepared to understand the second advent of power-reversing gears. It has probably been thirty years since the first steam reversing gear was used in this country, after a few years' use of which on a very small number of locomotives it was abandoned. In those days the valves were small and there was no difficulty in handling them very satisfactorily with the reversing lever. Now, however, the conditions are entirely different, and, in addition to the heavy weights to be moved, the wide fire-box prevents in many cases a good practical application of the time-honored reverse lever. In some cases it has been necessary to use a power reverse simply because a satisfactory hand reverse lever could not be worked in with the type of boiler used. These considerations are of sufficient importance to necessitate the complication of the power reverse gear, so that it is not likely that it will be relegated to oblivion, as was the attempt made many years ago.

There are several types of power-reversing gears, but we believe that the type in which the movements of the engineer resemble those of the ordinary reverse lever are most desirable, particularly when engines are placed in the chain gang and are not operated with a single crew. Thus, in the reversing gear which is illustrated by Fig. 7, the engineer simply pushes a small lever to the desired position and the reversing engine automatically moves the valve motion until it has assumed a position corresponding to the hand lever, and, while this hand lever may be reversed with a very rapid movement, yet the engine itself will pull the motion back slowly but surely, regardless of the speed with which the engineer has moved the controlling lever.

While piston valves have long been used in marine engineering, the general use of them in locomotives dates back a little more than ten years. The Vauclain compound locomotive with the high and low-pressure cylinders superimposed, one above the other, was operated by a single piston valve for the two cylinders, this reducing the mechanism to a much simpler form than could be accomplished by means of slide valves. Previous to this there had been very few engines of the simple type equipped with piston valves, but the success which attended the use of the piston valve with the Vauclain compound induced its extension upon locomotives operated by single expansion only.

When the piston valve is used to replace an ordinary slide valve it is of a very simple type, and is practically a slide valve extended into a circle, with packing rings used at the several steam and exhaust edges. There has been considerable discussion as to the value of these valves as compared with slide valves, and a number of tests have been made, some showing better for one, some showing more economy for the other. There is little doubt but what this question of economy depends greatly upon the maintenance of the valve and the condition in which it is allowed to run, as a leaky valve of either type would, of course, be very wasteful of steam.

One of the principal advantages of the piston valve is the fact that it is fully balanced and easier to manipulate the engine than with a slide valve, even of the balanced type. As a matter of fact, piston valves are generally manipulated with greater ease when the throttle is open than when it is closed; still, the converse is true of balanced slide valves.

In spite of the fact that there is some doubt as to whether the piston valve is really more economical in steam consumption than the slide valve, yet they have been introduced in great numbers, partly due, no doubt, to the fact that the large cylinders require large ports, and the port opening with the piston valve can be made nearly double that possible with an ordinary slide valve. The large valves also are very little harder to handle in the cab than those of smaller diameter. Another advantage lies in the fact that piston valves can be, and generally are, so designed that the steam enters at the center, or central admission, as it is called, and exhausts into the ends of the chamber, the valve being hollow, permitting both ends of the steam chest or valve chamber to be in communication with each other. This reduces the pressure on the valve stem packing to that of exhaust steam only, and when it is considered that the variable travel of the valve makes it much more difficult to maintain packing on the valve rod than on the piston rod, which travels the same distance and forms no intermediate shoulders, the advantage in relieving this packing of high pressure steam will be at once appreciated.

Reference was made above to the fact that in the Vauclain compound of the superimposed cylinder type one valve was able to regulate the admission of steam to both cylinders. In this case both the pistons worked together, being attached to the same crosshead. A later type of the balanced compound, in which the pistons move in opposite directions, has also been successfully worked by one valve, resulting in extremely simple mechanism for this type of engine.

The advantages of the Allen ported slide valve for the quicker admission of steam to the cylinders has long been appreciated, but this has not been generally introduced into piston valves, one reason, no doubt, being due to the fact that the much larger valve opening, on account of the greater length of port, made it unnecessary. With the increasing size of cylinders and the greater speeds at which it is desired to operate large tractive forces, it becomes necessary to adopt a somewhat similar arrangement for piston valves. This has been developed into the doubled ported piston valve, whereby there are two ports or openings, both for steam and for exhaust. The advantage of this is that a higher steam line or pressure line can be maintained in the cylinder up to the point of cut-off and less back pressure during the period of exhaust, as the steam has twice the area of opening when near the points of port opening and closure than could be obtained with an ordinary valve of the same size. As this port is placed partially in the valve chamber bushing, there is little additional complication added, except in making the valve itself, but the cylinder casting can be molded as easily in one case as in the other. While this is a very recent development, yet it promises such good results that we believe its quite general adoption is likely to be only a question of a short time.

While the boilers of locomotives have increased enormously in size, there has been little change in the actual design and construction. Of course, the larger diameters have given occasion for the introduction of thicker sheets and for joints of increased efficiency. The old double-riveted lap joint, which had an efficiency of about 70 per cent, has been superseded almost universally by the butt joint, with an efficiency of from 80 to 90 per cent. Besides reducing the thickness of the shell sheet, the butt joint pulls centrally and removes the cause of grooving, which was so often found when boilers were provided with lap joints, no matter how strongly they might be riveted. This grooving was due to the eccentric pull of the two sheets on the joints, and has been largely responsible for shell ruptures. It is, moreover, difficult to see before trouble ensues, but it reduces the section of the plate by starting a fracture at the caulking edge of the inside lap. The butt joint which has generally been introduced has a wide inside and a narrow outside cover plate, but in some cases the diamond joint has been introduced, which makes a very stiff shell at the joint. Seams have been welded, not only at the ends but sometimes for the whole width of the sheet, but, as a rule, a cover plate is put on in addition to the weld, so as not to depend entirely upon the welded joint. There are different ways of making these welds, sometimes by means of direct flame or fire, sometimes with an electric arc, and sometimes with acetylene, the latter coming now into more general use as the apparatus is portable and does not require connection with any source of power to provide current.

Cast metals have almost entirely disappeared from boiler construction, whereas in former times, with low pressures, it was considered permissible to use cast-iron dome rings and dome caps, yet these are now invariably made of pressed steel. The complete dome is sometimes pressed out of a single sheet of metal.

The fire-box itself has been affected principally by the introduction of flexible staybolts. These are generally of two types, one with a spherical end encased in a cup screwed into the sheet, of which the Tate is perhaps the best illustration, and another one consists of a hinged bolt, of which the "Breakless" is the best known example. These were introduced to reduce the great number of breakages which some lines experience, particularly in the corners or ends of the fire-box. Some roads even go so far as to specify that all of the fire-box staybolts shall be of the flexible type, while the majority of roads are satisfied to put in only 300 or 400 of such special bolts. These bolts add about 50 cents each to the cost of a locomotive, and the question has recently been raised as to whether they are really giving the immunity from breakage which has been contended. The staybolt problem is rather a difficult question, inasmuch as if we make the bolt larger in diameter it will be stiffer and still less likely to stand transverse strain. With increasing pressures we cannot well make them thinner without reducing the spacing, and this is undesirable on account of the likelihood of the water space being choked up with mud. Then, staybolts are likely, if overheated, to let the crown sheet drop, and for this reason it is good practice to use button-headed bolts for the central rows of the crown sheet stays. The wide fire-boxes have long caused the practical disappearance of crown bars, so that there are practically either radial-stayed or Belpaire type of boilers in general construction at the present time. With the Belpaire the crown sheet is naturally level, but with the radial-stayed the high portion which would be first to be uncovered by low water is often protected by button-headed bolts. Some, however, think this a disadvantage and would prefer that a short section of the crown sheet should let go and relieve the pressure without pulling down the whole crown sheet. Records pf locomotive boiler explosions, including dropped crown sheets, seem to indicate that less than 2 per cent are due to deficient strength, and that practically all of the disasters are caused by low water, either through the negligence of the engineman or some difficulty with the water feeding or indicating devices.

In recent years the Jacobs-Schupert fire-box has been introduced as practically indestructible with even extraordinarily careless treatment in connection with fire and water. This boiler is composed of sections riveted to diaphragm sheets, so that no staybolt is used in the construction of the boiler, and some remarkable results of tests have indicated that it is very difficult, if not impossible, to cause a disaster by means of low water, even

with a hot fire in the fire-box. Of course, this fire-box is more expensive to construct, and it is questionable whether the railroads would feel it necessary to pay this increased cost as an insurance against such troubles.

The inside of the fire-box is occasionally provided with arches of various types; some of these rest on tubes and some on studs, some are made of solid bricks, and some are of hollow bricks with openings through the front water leg to introduce air for combustion. Some tests recently made showed that there was little, if any, efficiency or economy afforded by means of jets of air brought in through the arch brick, and the greater expense of the brick and the difficulty of maintaining them would seem to give preference to a solid brick, particularly if there was no gain over the hollow tiles. However, these questions of combustion have been so much discussed and disputed, and as results of different tests are likely to show such a variety of results, it is doubtful whether the question of the value of the brick arch and its various forms for admitting hot air, etc., will ever be satisfactorily settled in any one way to the community at large. Most people agree that the brick arch has a very positive value in connection with smoke abatement and fuel economy; yet in some sections of the country where the flues need frequent rolling and beading it is almost impossible to maintain an arch for any length of time, and it often prevents the quick turning of a locomotive, as the man cannot get in the fire-box or remove the arch until it has become sufficiently cooled. These practical considerations are often much more important in a locomotive than the mere theoretical consideration of fuel economy, as the business of moving trains is of primary importance, and anything that increases the roundhouse work or detains the locomotive at a terminal is bound to give way to the urgencies of transportation.

To be continued.

Diffusion of Education and Knowledge*

Illiteracy and Literary Productiveness in Different Countries

By Arthur Macdonald

The educational status of a nation consists in the amount of literacy, number of teachers, and number of persons in its primary and secondary schools, and in its colleges and universities, relative to population. The status of knowledge may be indicated by the number of books, periodicals, and newspapers relative to population. This knowledge may take two forms, one gained through books, the other through periodicals and newspapers. One is knowledge in general; the other consists more in current information.

The question may be asked, if a community or country leads another in literacy, diffusion of education and knowledge; if, relative to its population, it has more pupils in school, more teachers, more students in colleges and universities, more books in its libraries to read, and more periodicals and newspapers to peruse, is not this country or community, as a whole, very probably better educated and more intelligent than the other country or community? While there are exceptions due to special conditions, we are disposed to answer this question in the affirmative.

Table I indicates in a general way the diffusion of education and knowledge in some leading countries.

Column 1 gives the relative amount of illiteracy among army and navy recruits. As these are mostly adults, they probably represent best the real amount of illiteracy. Column 6 gives the number of publications (relative to population) in the list of the Smithsonian Institution in Washington. These publications are of the highest class, including journals issued by learned societies and governmental institutions.

Examining Table I it will be seen that Switzerland is much in advance of all the other countries in general diffusion of education and knowledge, and Russia is last. Italy also is very low in these respects. France shows a high degree (next to Switzerland) of diffusion in university education (81) and newspaper information (251). Germany shows the lowest degree of illiteracy and publishes the largest number of books, but not relative to its population. Denmark issues the largest number of books in proportion to its population.

The United States, compared with European nations, is next to highest (Switzerland) in number of newspapers issued, but next to lowest (Russia) in number of university students enrolled and books produced, relative to population.

TABLE I.

Country 1908	Education: Number of illiterates per 10,000 recruits	Education: Per cent. of population enrolled in schools	Education: Number of university students per 10,000 population	Knowledge and information: Number of newspapers per million population	Number of books published per 100,000 population	Smithsonian list: Number of publications per million population (1904)	Number of books published	Number of newspapers and periodicals issued (year)	Smithsonian list: Number of publications (1904)
Column	1	2	3	4	5	6	7	8	9
Belgium	833[1]	12·2	68	27	28	48	2763	209 (1908)	354
Denmark	20[2]	13·0	—	84	135	42	3519	220 (1908)	112
France	346[1]	14·2	81	251	28	42	8799	9877 (1908)	1723
Germany	4[1]	17·0	65	115	49	39	33317	7000 (1907)	2390
Great Britain and Ireland	100[1]	17·0	56	98	22	45	9821	4400 (1905)	2038
Italy	3072[3]	8·1	77	60	21	24	6918	2067 (1904)	834
Netherlands	210	15·0	72	132	56	36	3258	760 (1906)	207
Russia	6110[4]	4·5[5]	16	8	—	3	23852	2229 (1905)	515
Switzerland	9	18·6	178	275	116	90	4256	1005 (1907)	351
United States	380[6]	19·7	20	260	10	—	9254	21320 (1908)	—

[1] 1904. [2] 1897. [3] 1903. [4] 1895. [5] 1907: in 1907, 39 per cent. of males and 27 per cent. of all persons (9 years of age and more) were able to read. [6] In white male population 21 to 24 years of age in 1900.

TABLE II.—*Book Production—Per Cent. for Each Subject.*

Country 1908	Medicine	Law	Philosophy	Religion	History	Sociology	Literature	Education	Art	Science	Military science	Fiction
Belgium	5·7	7·0	2·6	3·8	13·4	8·6	17·3	3·8	6·2	7·0	1·1	—
Denmark	3·7	1·1	1·2	9·6	—	—	23·2	3·3	2·2	9·7	—	—
France	10·5	6·3	2·1	7·3	17·3	6·4	22·0	11·4	1·2	4·5	3·9	—
Germany	5·8	10·0[1]	2·3	8·4	9·0	10·0[1]	19·5	13·8	2·9	5·7	2·3	13·7[4]
United Kingdom	3·1	2·6	—	9·5[2]	13·9	6·7	18·4	6·4	—	11·8	—	2·6
Italy	7·6	4·9	2·8	4·4	12·0	6·7	14·1	13·1	2·6	5·8[3]	1·9	6·3
Netherlands	3·3	5·3	—	6·2	—	5·3	—	9·3	—	5·3[3]	—	—
Russia	4·6	3·1	—	6·8	3·0	—	10·2	7·9	—	2·5	—	—
United States	3·6	9·9	1·9	8·8	14·7	5·9	13·3	4·5	2·5	5·1	—	16·0

[1] Law and political science. [2] Religion and philosophy. [3] Science and technology. [4] Belles lettres.

Since we are disposed often to estimate countries as to their mental status or literary production without reference to their population, we will compare the countries in Table I according to the absolute number of books, periodicals, and newspapers published, as given in columns 7, 8 and 9.

As to largest number of books the rank is Germany, Russia, Great Britain, United States, France, Italy, Switzerland, etc.

As to number of newspapers and periodicals, United States is unique, publishing twice as many as France (next in rank), and from three to ten times as many as some of the other countries.

As to the Smithsonian list of publications, the rank is Germany, Great Britain, France, Italy, Russia, Belgium, Switzerland, etc.

If we take the extremely illiterate countries, as Russia, Italy, and Belgium, we find a correspondingly low percentage of the population enrolled in the public schools and a relatively low percentage of newspapers published. But when we come to the number of university students enrolled, the correspondence fails as to Italy and Belgium, which have, relative to population, a larger number of university students than Germany or Great Britain. As to the number of books published relative to population, the correspondence fails in the case of Belgium, which produces as many books as France (column 5), relative to its population. As to the Smithsonian list of publications, the correspondence fails in the case of Belgium, which is next to the highest (column 6).

If, now, the countries distinctly the least illiterate, as Germany, Switzerland, and Denmark, are compared in respect to enrolment in schools or primary education, the correspondence fails in the case of Denmark, which is behind France, Great Britain, and the Netherlands. There is no further correspondence of these three highly literate countries in the other educational columns.

In brief, there appears to be but little necessary relation in these countries between degrees of education and amount of literary production. Thus, Italy, with its great illiteracy, stands very high in university education. This is interesting in connection with the fact that Italy is doing some of the best work in sociology, which is suggestive in connection with the further fact that she stands next to the highest in production of sociological works.

The United States has a large percentage of illiteracy, yet ranks highest in percentage of population enrolled in schools, but has the smallest number of university students. It has next to the largest number of newspapers, but produces next to the smallest number of books. Russia, about which data are more difficult to obtain, stands lowest in all respects relative to its population.

Different countries naturally do not classify books in the same way, and sometimes one country will include under one head publications that other nations would place under another subject, and hence results given in Table II must be taken in a general way.

In order to render the table more trustworthy, we have included two or more subjects under one head. For instance, under "History," both "Biography" and "Geography;" under "Literature," "Poetry," "Fiction," and "Drama," and under "Religion," "Theology." "Fiction" is both put by itself and also combined with "Literature."

A few headings could not be classified nor combined with others and were omitted, so that the table is not complete, but the percentage for each subject given is, of course, not affected.

It may be interesting to note the kind of books some countries prefer, as shown in Table II. Thus, France publishes relatively more medical works (10.5) than any other nation here mentioned. Italy is second (7.6) and Germany third (5.8) in this subject. Belgium publishes relatively the most law books, Denmark the fewest. United States Denmark and Germany lead in religious works. Denmark and France excel in literature, and Germany and Italy in educational work, and France in books on military science.

Although correspondence between mental and patho-social conditions, or concomitant relations, does not necessarily indicate causal connection, yet it is interesting to note a few instances. In general, those countries which have the greatest illiteracy, as Italy, Belgium, and France, show the highest percentage of murder. They also have a high percentage of still-births, death-rate, and death-rate under one year of age. Two of these countries, where the illiteracy is more pronounced, as in Italy and Belgium show a low rate of suicide and divorce. On the other hand, the least illiterate countries, as Germany, Switzerland, and Denmark, have a high rate of suicides.

* From a paper on "Mentality of Nations in Connection with Patho-Social Conditions," in *The Open Court.*

Auto-sleighs for Russia.—There is a good field for automobile sleighs in Russia, and in order to promote the use of this mode of locomotion there is to be held an international concourse of motor sleighs during the latter part of January. It is organized by the Imperial Russian Automobile Club and will take place at St. Petersburg. The trials will be held upon one of the branches of the Neva which will give a good surface of ice or snow, and also on the roads of Krestowsky Island. Runs of 3 miles are to be made upon the road and 2 miles upon soft snow, and the motor sleighs are expected to show their usefulness in places where automobiles cannot run. Commemorative gold medals will be awarded to the winners of all the contests and silver medals for success in single trials, and there will also be a special cup awarded for a speed race.

"Life After Death"*

The Survival of Isolated Tissues

By R. Legendre

The Nobel prize in medicine for the year 1912 has been awarded to Dr. Alexis Carrel, a native of Lyons, France, but now attached to the Rockefeller Institute in New York, for his researches on the suture of blood vessels and the transplantation of organs. Dr. Carrel has also contributed much to our knowledge of the subject of this article. The newspapers often publish stories of the "culture" of excised tissues and some journals have asserted that living tissue can be caused to increase and multiply outside the body. As I have studied the problem I desire to state just what has been done and what we can hope to do.

The idea of prolonging the life of excised parts of the body arose in many minds almost simultaneously, and although the objects sought were diverse the experimental results achieved have been much alike. Surgeons, long accustomed to grafting skin and other tissues, and even transplanting organs, sought to prolong the vitality of their grafts. Physiologists endeavored to isolate organs and keep them alive, in

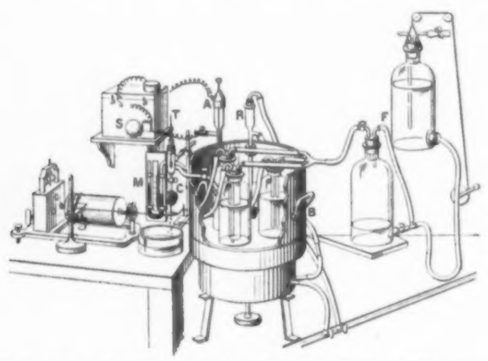


Fig. 1.—Pachou's Apparatus for the Study of the Isolated Mammalian Heart.

B, water bath; *R A S*, thermostats; *T M*, thermometer and manometer for the serum entering the excised heart *C*; *F*, reservoir of oxygen under pressure; at the left, a cylinder for registering the contractions of the heart.

order to simplify their experiments by eliminating the complex influences of the glands and the nervous system. Cytologists desired to keep cells alive outside the body for the purpose of studying them in simple and definite conditions. These diverse efforts have yielded results of great value, both for the theoretical knowledge of vital phenomena and for the practice of surgery.

Many organs have been kept alive for a longer or shorter period. The heart has been the subject of the earliest, the most numerous and the most complete researches, because it best endures the arrest of the circulation, and also because its vitality is clearly indicated by its contractility. In man, the heart has been observed to beat spontaneously and perfectly 25 minutes after a judicial decapitation (Renard and Loye, 1887), and the beat has been restored, 100 minutes after it had ceased, by massage of the heart (Rehn, 1909). A dog's heart is able to beat 96 hours, a tortoise's heart 8 days, after the animal's death, and Burrows (1911) has seen the heart of a chick beat regularly 3 days after its removal. The life of an excised heart can be greatly prolonged by irrigating the organ, and especially by irrigating the coronary blood vessels.

The first experiments in maintaining artificial circulation in the excised heart were made in Ludwig's laboratory and perfected by Kronecker (Fig. 2), but these

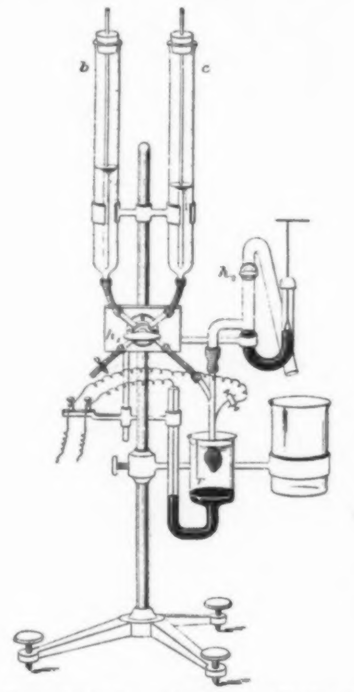


Fig. 2.—Kronecker's Apparatus for the Study of Frogs' Hearts.

b c, reservoirs of defibrinated blood; *r*, vessel in which the heart is suspended from the end of a double tube, through which the artificial circulation is maintained; h_1, distributing cock; h_2, cock of outlet communicating with manometer.

experiments were confined to the hearts of frogs and lower vertebrates. In 1891 Arnaud observed that the heart of a rabbit recommenced beating when defibrinated blood was injected, under pressure, into the coronary arteries, and in 1891 Hédon and Gilis obtained the same result with the heart of an executed criminal. From the results Langendorff, in 1895, developed a method of prolonging the life of the mammalian heart by artificial coronary circulation. Locke, in 1901, substituted for defibrinated blood an artificial serum destitute of corpuscles. Since that date such experiments have multiplied and have become classical. By means of artificial circulation an excised human heart has been kept beating normally 20 hours (Kuliabko, 1902), a monkey's heart 54 hours (Hering, 1903), a rabbit's heart 5 days (Kuliabko, 1902), etc. The same device has made it possible to study the influences exerted upon the isolated heart by temperature, isotony, various salts and ions, and even complex pharmaceutical preparations. Kuliabko (1902) succeeded in observing the contractions of a rabbit's heart and a cat's heart that had lain in an ice-box for 18 hours and 24 hours, respectively.

Analogous researches have been made with other muscular organs. The striated muscles long survive extirpation, especially if they are kept at the temperature of the body and protected against dessiccation. Many studies of muscular contraction have been made

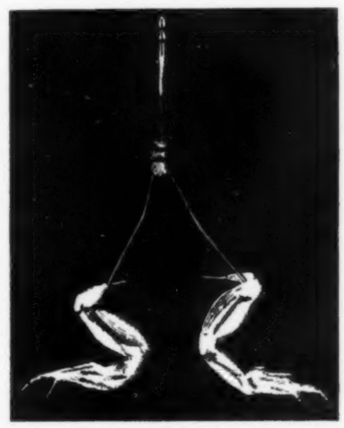


Fig. 3.—Nerve Centers of Frog, After 31½ Hours' Survival (Bagliom, 1909).

on excised muscles. Landois found that human muscles contracted 2½ hours after removal from the body, and that muscles of the frog and tortoise retained their contractility for 10 days. Burrows (1911) observed a slight increase in the myatonies of a chick after 2 to 6 days survival in coagulated plasma.

Organs which have unstriated muscles survive equally well, at least so far as the muscular layer is concerned. The small intestine continues its peristaltic movements long after the death of the animal. Cohnheim, Magnus and others have prolonged the motion by bathing the intestine in defibrinated blood. Hédon and Fleig have observed contractions in an intestine kept 7 days in cold artificial serum. The stomach, the large intestine, the ureters and the uterus are equally resistant. Fleig (1910) succeeded in exciting by electricity the oesophagus of the rabbit after 12 days' refrigeration, and the pharynx and oesophagus of the frog after 17 days.

Organs that are not muscular likewise survive removal from the body, but the proof of their survival is more difficult, because of the absence of movement. Carrel, in 1906, grafted fragments of blood vessels which had been kept on ice for several days, upon a blood vessel of a living animal of the same species. In

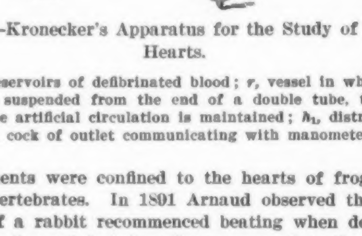


Fig. 4.—Amœboid Movements of a White Corpuscle of Frog's Blood, After 10 Months' Survival (Jolly, 1910).

* Abridged translation prepared for the Scientific American Supplement from *La Nature*.

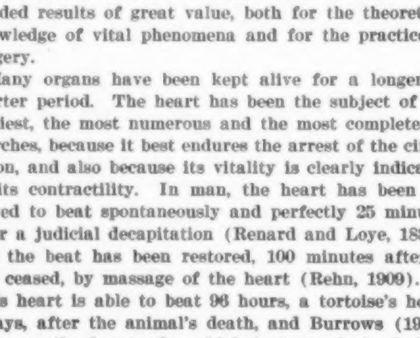


Fig. 5.—Ganglion Cell of Dog, Surrounded by Prolongations Formed After Excision (Legendre and Minot, 1911).

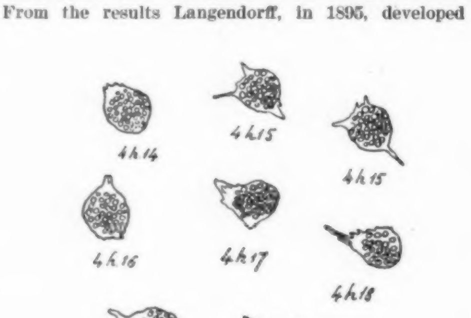


Fig. 6.—Part of Sensory Ganglion of Dog, 27 Hours After Excision, Showing New Prolongations. (Legendre and Minot, 1911).

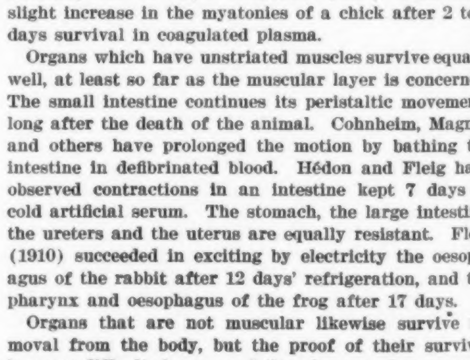


Fig. 7.—Fragment of Nervous System of Chick, With Newly Formed Prolongations of Nerve Fibers (Burrows, 1911).

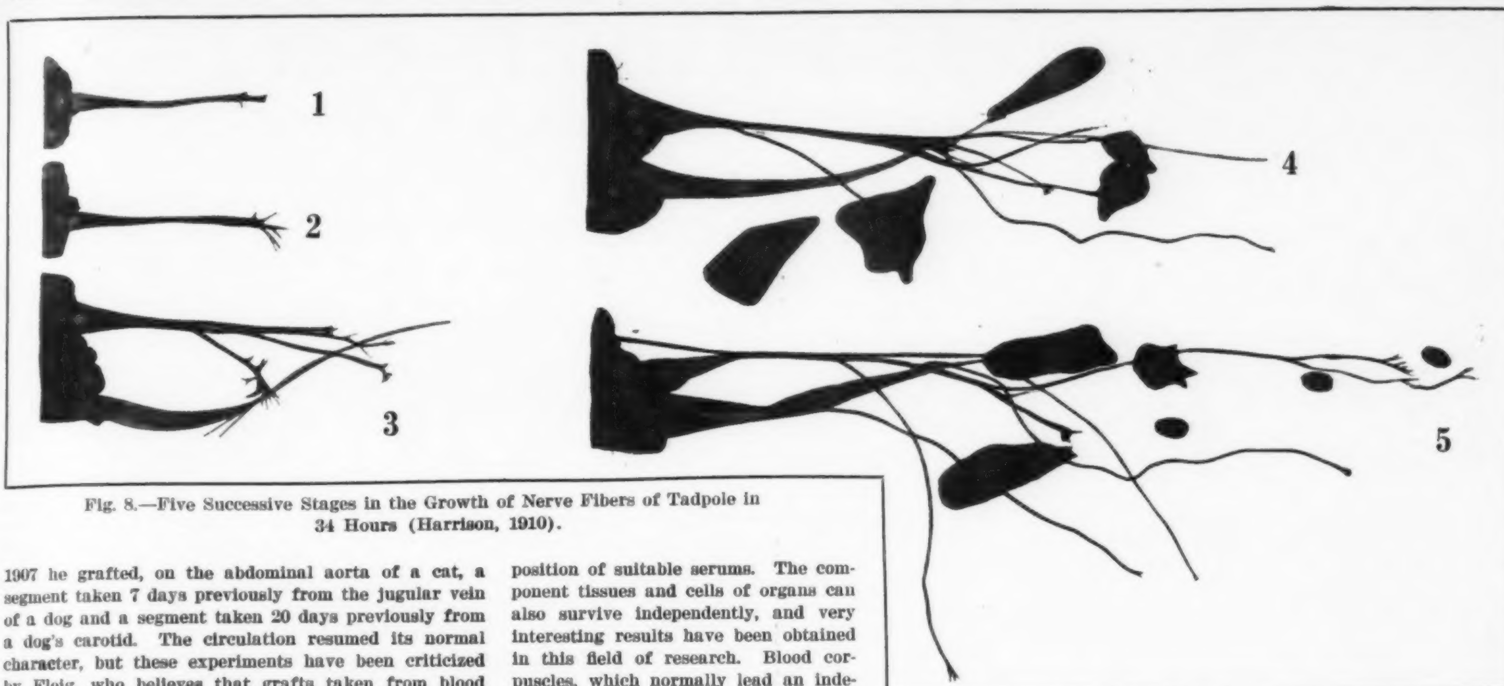


Fig. 8.—Five Successive Stages in the Growth of Nerve Fibers of Tadpole in 34 Hours (Harrison, 1910).

1907 he grafted, on the abdominal aorta of a cat, a segment taken 7 days previously from the jugular vein of a dog and a segment taken 20 days previously from a dog's carotid. The circulation resumed its normal character, but these experiments have been criticized by Fleig, who believes that grafts taken from blood vessels die and serve only to sustain and direct the regeneration of the vessels on which they are grafted. In 1909 Carrel removed the left kidney from a dog and replaced it 50 minutes after its excision. The other kidney was subsequently removed, but the animal remained in good health for more than a year, thus proving the success of the graft. In 1910 Carrel made similar and equally successful experiments upon the spleen.

Even nervous organs can be kept alive outside the body. In 1885 Laborde found that artificial circulation, established 20 minutes after the execution, produced no movement in the head of a decapitated criminal, but that the cerebral cortex remained excitable for 50 minutes. In another subject cerebral excitability was preserved 30 minutes without transfusion. In the dog, Loye detected cerebral irritability 7 minutes after decapitation; Brown-Séquard observed spontaneous movements of the face and eyes 10 minutes after decapitation; Guthrie, Pike and Stewart, with the aid of artificial circulation, were able to observe reflex movements for 19 minutes, reflexes of the cornea for 27 minutes and respiratory movements for 30 minutes. In the heads of fishes Kuliabko preserved the activity of the nervous centers for several hours after decapitation by means of a circulation of artificial serum.

It has been known since Galvani's famous discovery (1781) that a frog's legs, skinned and attached only by the sciatic nerves to a segment of the spinal cord, remain irritable for several hours. Baglioni has recently succeeded in isolating the entire cerebro-spinal axis of the toad and keeping it alive in artificial serum for 31½ hours. I, myself, with Dr. Minot's assistance, have kept alive for 4 days the excised sensory ganglia of adult dogs.

These researches show that most organs, if not all, can survive removal from the body for a longer or shorter period, if favorable conditions are provided. No doubt the period of survival will be considerably extended when we shall have learned more about appropriate physical and chemical conditions and the composition of suitable serums. The component tissues and cells of organs can also survive independently, and very interesting results have been obtained in this field of research. Blood corpuscles, which normally lead an independent life, were the first cells studied. The red blood corpuscles of the triton have been kept alive in tubes from 8 to 15 days and have even been observed to increase by cell-division (Jolly, 1903). The red corpuscles of rabbit's blood have lived 12 days in the ice-box (Fleig, 1910). White blood corpuscles, the vitality of which is infallibly indicated by their amœboid movements, have been kept alive in glass tubes for 12 days (Cardile), 21 days (Recklinghausen), even 25 days (Rannier, 1895). The white corpuscles of the triton and the frog retain their mobility 4½ months and 12 months, respectively, in the ice box (Jolly, 1910) (Fig. 4).

Many experiments have been made with organized tissues. The ciliated epithelium of the larynx, trachea and bronchi of mammals continues to vibrate 24 hours after death. Grawitz (1897) observed ciliary movements in human nasal epithelium 9 days after its removal in the course of an operation. Wentcher (1894) successfully grafted human skin 50 hours after excision, and Ljungren (1898) obtained equal success after a month of survival. Grawitz (1897) grafted a fragment of a horse's cornea 12 days after its removal. Pruss (1900) preserved the vitality of cartilage for 30 days.

During the last three years many researches on the survival of tissues have been made, and the histology of the tissues and the conditions favorable to survival have been studied with care and success. In 1910 Harrison observed that fragments of tadpoles continued to grow during several weeks, when kept in the coagulated lymph of an adult frog. The muscles and the epidermis differentiated, and the rudimentary nervous system developed filaments resembling nerve fibers (Fig. 8). Dr. Minot and I have preserved cells of the spinal ganglia of dogs and rabbits in defibrinated blood of the same animals for 4 days, during which many new nerve fibers were formed (Figs. 5 and 6). Burrows, employing Harrison's method, has obtained with fragments of chicks results analogous to those obtained with tadpoles by Harrison; Carrel and Burrows have applied the same method to what they call the "culture" of various tissues of dogs and rabbits. In this way they have preserved and even multiplied cells of cartilage, thyroid, kidney, bone-marrow, spleen, cancer, etc.

Perhaps Carrel and his collaborators may be criticised for applying the term "culture" to mere survival and for sometimes failing to distinguish phenomena of degeneration from those of real survival, but their researches are, nevertheless, most interesting and significant.

In conclusion I will mention a series of experiments which indicate the benefit that surgical practice may derive from these researches. In 1911 Magitot successfully grafted on the eyes of rabbits fragments of cornea taken from other rabbits 14 and 25 days previously.

Subsequently, he removed a portion of the opaque cornea of a man who had been blinded by quicklime, and substituted a piece of cornea taken from an eye which he had removed from another patient 7 days before, and which he had preserved in serum. The graft was a complete success, and the blinded man was soon able to see, through his substituted cornea, well enough to find his way about.

Without going so far as the dreams of Dr. Moreau and the romancer Wells (for successful grafts can be made only between animals of the same species) we may fairly hope that it will soon become practicable to replace diseased organs and tissues, in many cases, with healthy material taken from other patients and preserved for that purpose.

These researches also possess great scientific interest. I believe that they will enable the physical and chemical factors of life to be studied in unusually simple conditions, and I am prosecuting them with this object in view. They will bring us much nearer to the solution of the old unsolvable problem of life and death. What, indeed, is that death which every part of an organism can survive for a longer or shorter period?

Enlarging the Agricultural Unit*

By E. Davenport, Dean of the College of Agriculture, University of Illinois

One peculiarity of agriculture and of country life lies in the fact that the family has been not only the social unit but the business unit as well. Whatever future development may bring about socially, nothing is clearer now than that this unit is too small for economic purposes. There are three great business operations which require a larger unit than the single family for their best transaction; namely, credit, the selling of products, and the buying of supplies.

It is strange indeed, as we think of it, that the last of these three, which is of the least consequence of all, was the first one in which reform was attempted largely through the efforts of the Grange. It is perfectly clear upon slight reflection that the selling end of farm affairs is of much more consequence than the buying. The farmer is not a large buyer, but he is a large seller. So far as buying is concerned, he can quite well afford to avail himself of the same machinery by which others are supplied; but the question of selling is more complex, and for obtaining credit he has no proper machinery whatever. Both of these problems require some form of combination.

The fruit growers of the West have been compelled to find the solution of the selling problem, having learned by bitter experience that as long as the individual operated as he had done in the East, no profits were possible; and the German farmers have shown a way by which the pooling of land holdings may constitute the very best possible credit for temporary loans at low rates of interest.

Jones alone will never be able to reach a distant market, nor will he be able to furnish a constant food supply of standard grade, unless he happens to be a man of unusual brains operating on a large scale; however, as soon as his produce is handled by a company of which he is a member, it is at once standardized, and the producer and the consumer alike are protected by a disinterested party—a combination that is mutually profitable.

The same conditions obtain in temporary loans. Jones, desiring a short time loan, goes to the bank. He is able to offer what, from considerations of safety, is the best security in the world—land. It is not, however, good bankable security, and the result is that he pays the highest rate of interest. As soon as he combines with his neighbors, he is able to arrange for large loans on longer time than that with which an individual could be accommodated, and at a much lower rate of interest.

It is perfectly evident that evolution in this direction must come. The great obstacle to it is the intense individuality of the American farmer, which is bred in the bone and nourished by generations of independent business. It will require the leadership of the best men to organize and set in motion this new machinery.

* Reproduced from *Business in America*.

War and the Survival of the Fittest—II*

Does Physical Conflict Between the Nations Select the Highest Type?

By Robert M. Dickie

Continued from SCIENTIFIC AMERICAN SUPPLEMENT No. 1931, Page 3, January 4, 1913

Yet it must be granted that in great areas of life there is a struggle of life with life in which the weaker are eliminated and the stronger survive. It is sufficiently common to be reckoned among the facts of natural history which powerfully affect its course. Leaving for the present purely biological considerations, it may be granted that it has always been a serious feature in human life. Can it be said that such struggle has been an instrument of progress? We need not here discuss the question as to whether or not the bloody encounters of individuals did insure the survival of the most fit. Let us pass at once to those forms of community warfare where one group of persons bound together in a certain solidarity of life and interest comes into conflict with another similar community. This warfare goes back to the dawn of history; community has been warring with community from the beginning. How has this affected the progress of the race? Has it been analagous to the process of natural selection which has insured real progress? Advocates of the natural history theory of morals assure us that it is in this way the race has learned the rudiments of morality and made such progress in morals as we have. In cases where community came into conflict with community among primitive men, Leslie Stephen assures us that other things being equal, the community with highest development of "social tissue" won. In those communities where individual members had learned to subordinate their individual and immediate interests to the interests of the community there was a superiority over the communities where these features of life were less marked, a superiority which warfare vindicated. "Social tissue" in the long run won the day. Communities in which it was weak soon disappeared in the primitive condition of universal war and communities with the finest "social tissue" survived and perpetuated themselves. Just as rotifers of infusoria poorly adapted to the forces of nature among which they lived died off, and those more perfectly adapted survived, so it is said, communities of weak social tissue were unable to adapt themselves to that most serious feature in their environment, the pressure on all sides of hostile communities bent on fighting, and were eliminated while others of stronger "social tissue" were able to adapt themselves and survive.

In an examination of this argument it is well at the outset to remind ourselves that it is very easy for a theorist who writes natural history in an a priori fashion to greatly magnify the fighting propensities of primitive communities. There is no reason for believing that warfare was universal among such. In the first place communities are not clearly defined like individual organisms. A family is a community, but so is a clan or a tribe including many families, and in later social developments we have larger communities, such as the nation and the empire including many races. There is no reason for believing that among primitive men there was a constant warfare among the smallest communities, i. e., families. Such warfare as we know was among tribes. But such communities included smaller communities among which there was co-operation rather than warfare. Thus we may say that the earliest wars we know were based upon co-operation, the co-operation of smaller communities within the larger.

Again, in tribal wars it was not the rule that one exterminate the other. Among the warring tribes of the North American Indians, Algonquins, Hurons and Iroquois were for centuries mortal enemies, but no tribe was exterminated. One tribe might be smaller and another larger, one possessing a better territory than another, one flushed with victory, the other stinging with defeat; but Algonquin, Huron and Iroquois was each as much a real tribe with its only peculiar tribal life and characteristics after two centuries of the fiercest tribal wars as before. Such tribal warfare has issues far less disastrous to the life of these communities than extermination; it lessens their numbers, changes their locality or perhaps breaks the vanquished into lesser bands. In any of these cases the characteristics of the tribal life are not necessarily obliterated or suppressed. It cannot then be said that in tribal wars there is a process analogous to natural selection since the vanquished in war are not eliminated.

One of these effects of tribal warfare applies to all warfare among communities no matter how large or highly organized, and because of its important bearing upon the question of progress and war deserves some consideration. While it is not the rule of war to exterminate one of the contending communities, it is the invariable rule that both communities suffer in the loss of many of their individual members. If tribal war does not eliminate tribes it does eliminate many individuals. The same is true of all warfare. We must ask how this elimination of combatants affects the progress of the type of life. Is this a case of the survival of the fit such as ministers to the evolution of the species? On the contrary, whereas in the case of individuals engaged in mortal conflict it is the rule that the weaker and less resourceful are eliminated; in the case of communities at war it is the rule that the individuals who are eliminated are above the average in their respective communities. The fighting men of all primitive tribes were the pick of the community. Every one of them who fell in battle was a distinct loss to the present life and the future blood of his community. Whether the tribe won its battle or lost it, its life and blood were so far impoverished. In after generations such tribes would miss the unborn children of the strong, resolute and daring men who perished in the forefront of battle.

This has been the rule of all community war from the beginning and continues to be such. It has been a check on increasing population, but so has pestilence and famine. The question is, has it been such a check as serves the ends of real progress in the life of the race? Even when classed with pestilence and famine, war may be said to be decidedly inferior to either as a means of preventing over-population where such prevention has been necessary. Pestilence and famine as a rule cut off the weak and less sturdy stock, but war takes its tribute from the best the nation can bring. The maimed and infirm, the scrofulous and neurotic, the cowardly and irresolute escape this scourge and make their contribution to the life and blood of the nation. It is the best blood of the nation that is lost in war.

When we remember that war has been taking toll from the best blood of communities since the beginning it becomes evident that it has been a most serious detriment to race-improvement, if it has not actually made for race-degeneration. Generation after generation losing its best blood on the field of battle has only to proceed far enough to mean the bankruptcy of the nation, and every step means its impoverishment. Serious historians have found this process a prime factor in the downfall of the ancient empires. Dr. Otto Sieck attributes the downfall of Rome to this process of rooting out the best ("die Ousrottung der Besten"). Seeley says, "The Roman Empire perished for want of men;" the hardy stock from the foot of the Appenines whence the Empire had its vigor was drained by war. One historian of Greece discussing the Peloponnesian wars has said, "Only cowards remained and from their broods came the new generations." Speaking of the Greeks who a few years ago fled before the Turks, Dr. Starr Jordan says, "These never came from the loins of Leonidas and Miltiades, they were the descendants of the scullions and the stable boys whom Greece could not use in her imperial wars." Those who were unfit for war became the progenitors of succeeding generations, while little by little the best blood of the empire was spilled in battle. It has often been said that after the Napoleonic wars in which three millions of men of the best blood of Europe perished, most of them young and many of them childless, the average height of Frenchmen fell abruptly by almost an inch. But what of the national valor and resolution and daring when such a drain was made upon its most valorous and resolute and daring blood?

This effect of war is undeniable, even under present conditions. War still takes its toll from the best blood of the nation; and if it is true, as we have said, that the extermination of the weaker race is not the rule, it may be said that in modern national warfare the extermination of the weaker nation is unknown. Capital cities, forms of government, geographical areas, dynasties may be changed by war, but the life of the nation is not a matter of the situation of its capital city, or the personality of its ruler, or the outward form of government. The aspirations of the people and their traditions, their point of view and temper, these are the essential qualities of a people's life, and so far as they are characteristic of the group included in the nation they are only slightly modified by war. The utmost modern war does is to take the name from the conquered nation, change its form of government and its social affiliations, the common life of the people in its depths moves on in its accustomed way regardless of these surface movements. "There is," says Macaulay, "an empire exempt from all national sources of decay—that empire is the imperishable empire of our art and our morals, our literature and our law." In all the wars of the past century no national life has really been crushed. For more than fifty years Poland has ceased to figure as a nation in the councils of the nations. Partitioned as she is among the nations, hopelessly divided in government, the Poles are not German or Austrian or Russian, their temper has not been appreciably modified, their traditions are as dear to them as in the days of their independence. There is yet a real solidarity of life and spirit among them notwithstanding the loss of their autonomy of government and national visibility. France was crushed, so the expression goes, in a swift and decisive war with Germany, but the French national life is as much a fact in Europe as it was before the war.

Quite apart, then, from biological consideration, which we have seen to be irrelevant for our purpose, it seems evident that since the struggle between communities does not as a rule mean the extermination of the weaker community and its type of life, and that since it does invariably mean a drain on the best blood of both communities, there is in such struggle nothing analogous to the progress of natural selection in which the fit survive and progress is insured. Rather it seems that such community struggle, by its loss of good blood to both communities, has been a most serious barrier to such progress.

(To be continued)

* Reproduced from *Queen's Quarterly*.

Battery-Ringing Telephones*

System Specially Adapted for Small Installations

THERE is at the present time, and probably always will be, a considerable demand for the battery-ringing type of telephone instrument for short lines. These sets are much cheaper than the standard types, owing principally to the absence of the costly hand generator. They give very satisfactory service, are very applicable to code ringing, so that several sets may be bridged across one pair of lines, can be made very compact, and do not easily get out of order.

The disadvantage lies in their applicability to short lines only—say, up to two miles in length, or about 100 ohms resistance—owing to the large battery power required to ring the distant subscriber's bell when above this length of line is used. The transmission, or speaking efficiency can be made good up to thirty miles or so very easily, it being only the ringing trouble which condemns the battery-ringing type of telephone instrument for long lines.

For domestic sets, office use, lines between signal stations, railway work, factory systems, etc., they act admirably as long as the number of stations do not exceed four or five, which are as many as can be practically handled by code ringing. When above this number are required, and not above twenty sets, battery-ringing telephones may be used in connection with an intercommunication system. The latter, however, lead on to more complicated systems which we will not here consider.

The simplest of instrument circuits, and one frequently adopted for domestic service between, say, the dining-room and the kitchen, is the "Converser" or "Metaphone" system, which will ring only in one direction, so

* Reproduced from the *English Mechanic and World of Science*.

that the maid cannot possibly ring up the dining-room.

In the dining-room a simple wall-fitting is used containing a switch-hook actuating a spring contact. A cheap form of hand set, consisting of a transmitter and receiver joined in series is adopted, and a suitable push-key provided for ringing purposes. In the kitchen the above are provided, except that a trembler bell and the battery are installed and the ringing key eliminated.

The circuit is as shown in Fig. 1, the action being as follows: In the normal condition both hand-sets are on their respective switch-hooks, so that the springs of S 1 are opened and those of S 2 closed. When the ringing-key, R 1, is pressed the trembler bell in the kitchen is actuated by the battery, a short circuit being thrown across the line. After both hand-sets have been lifted from their switch-hooks the springs change the contacts, so that the circuits are through for speaking. The short is taken off the kitchen hand-set and the circuit is put through to the dining-room hand-set, so that we get the two transmitters, the two receivers, the bell, and the battery all in series. This circuit can be easily traced from the diagram of connections.

In the dining-room a press-key can be inserted in the hand-set handle to replace the hook-switch S 1, and this form is indicated in the diagram.

or ringing condition. The batteries in the two stations are joined up, so that the positive poles are connected to the same line, in which case they are acting in opposition, and no current passes. If, however, one of the ringing-keys is pressed, then a short-circuit is thrown across the line, and the distant instrument trembler-bell will ring by its own battery.

The speaking condition is as shown in Fig. 3, the hand-sets being, of course, raised from the switch-hooks, and the press-keys in the hand micros depressed. In the first place it will be noted that the trembler-bells at both stations are short-circuited by the switch-hook springs.

Considering the line circuit, it will be observed that, neglecting for the moment the opposing batteries, the receivers R 1 and R 2, and the secondaries S 1 and S 2 of the induction coils are thrown across the line at either instrument. The hand micro, press-key being down, current will pass from the battery B 1, through the transmitter T 1 and the primary P 1 of the induction coil. When the transmitter is spoken onto, the diaphragm (generally of carbon) is caused to vibrate in accordance with the sound-waves impinging upon it, and this varies the resistance of the transmitter, owing to the variation in the conductance through the carbon granules in the transmitter cell. This variation is largely due to the

known as "side-tone." The speech currents will also travel along the line wires, and, passing through the windings of the distant instrument receiver, R 2, cause varying magnetic pulls on the iron diaphragm, which therefore vibrates in a similar manner to the transmitter diaphragm T 1, so that sound-waves are propagated from it, and the original speech is, therefore, reproduced.

The complete diagram of connections, showing both the ringing and speaking facilities, is given in Fig. 4, from which the previously discussed circuits can be easily traced out. It will be noted that additional cells are used for ringing than for speaking. This is due to the fact that the current with which a transmitter will work is limited to about 1/10 ampere, a greater current than this causing unpleasant sizzling and frying noises in the transmitter, and thus greatly decreasing the transmission efficiency and the quality of the articulation. Two Leclanche cells give the most suitable current with ordinary transmitters.

For ringing, however, over lines of two or three miles in length greater battery power is required, so that additional cells are installed, and the transmitter circuit tapped of the first two cells, as shown on the diagram.

Another important feature about this circuit is that if the switch-hook becomes faulty, due to dirty or burnt

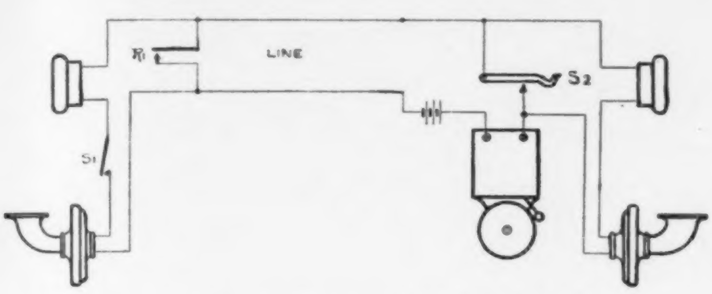


Fig. 1.—Simple System Ringing in One Direction Only.

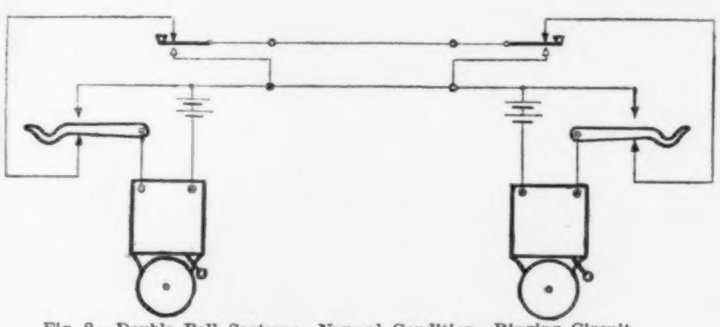


Fig. 2.—Double Bell System: Normal Condition—Ringing Circuit.

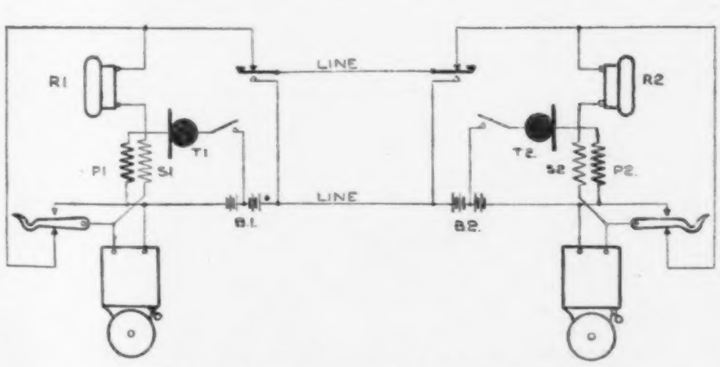


Fig. 4.—Complete Diagram of Connections.

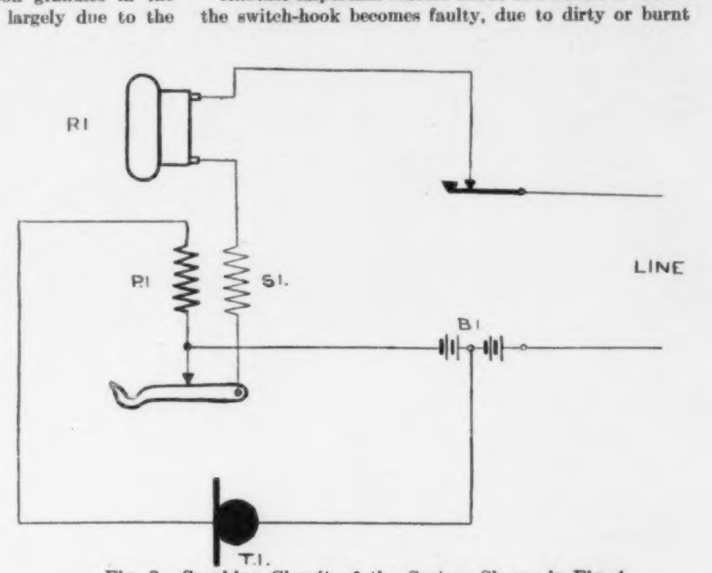


Fig. 3.—Speaking Circuit of the System Shown in Fig. 4.

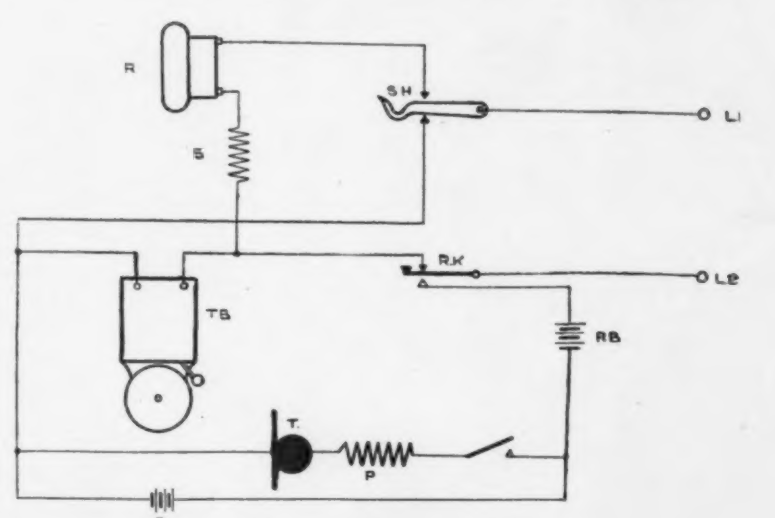


Fig. 5.—Another Type of Battery-ringing Telephone.

These sets are only of light construction and inefficient in working, so that where a reliable system is required, such as between offices, from a manager to a subordinate, etc., the following is generally adopted. The instruments are arranged so that ringing can be done in both directions, which necessitates the fixing of a trembler-bell and a ringing-key in each station, and the adoption of instrument circuits similar to that given in Fig. 4, which, it will be seen, is far more complicated than that of Fig. 1.

In the previous circuit (Fig. 1) the speaking is carried on through the bell, which offers a considerable impedance to the speech currents, so that the transmission efficiency is materially reduced. In these higher-class instruments there are fitted additional springs in the switch-hook, so that in the speaking condition the bells are either cut out or short-circuited, the latter process being generally adopted.

The circuits are more complicated, and will be taken in two stages: (a) ringing; (b) speaking condition.

Fig. 2 gives the arrangements of the circuits when the hand-sets are on their switch-hooks—i. e., in the normal

changes in the areas of contacts between the granules, resulting from the more or less pressure of the diaphragm upon them. While speaking into the transmitter we, therefore, get fluctuating currents passing through the local circuit comprising the transmitter and induction-coil primary.

The induction coil consists of two windings wound on a bobbin having a core composed of soft iron wires about No. 24 S.W.G. The inner winding is known as the primary, and is almost invariably of one ohm resistance, while the outer winding, the secondary, is generally of 25 ohms resistance, although sometimes much higher than this.

The fluctuating currents passing through the primary of the coil cause corresponding fluctuations in the magnetic state of the core, owing to the varying magnetic effect of the primary current. The change in the magnetic state generates alternating currents in the secondary winding of the induction coil by magnetic induction. These currents, which may be termed the speech currents, pass through the receiver R 1, reproducing there the speech originally spoken on to T 1, and giving the effect

contacts at the springs, etc., the circuit is still operative, the bell being actuated through the receiver and induction coil secondary, while the speech currents pass through the receiver, secondary and bell, the last, of course, cutting down the volume of the speech, but still allowing of fair transmission. This effect is obtained by using the short-circuited method of connecting up the instruments, instead of the cut-out or switch-over method, the receiver circuit or bell is cut out as needed.

Fig. 5 gives another type of battery-ringing instrument, in which the ringing is produced by throwing the battery across the line instead of short-circuiting the line terminals. This circuit has the advantage (a) that the batteries at the two stations need not be connected to the line in a specified manner. This latter point means issuing special instructions to the installer of the telephones, and also special care after the cleaning or renewal of batteries; and (b) owing to the batteries being off the line normally no trouble, due to the bells constantly tinkling, etc., can be given, due to their being out of balance.

The Trend in Automobile Construction

The Views of Automobile Engineers and Designers

Some weeks ago the Editor of the SCIENTIFIC AMERICAN *sent out a letter to the members of the Society of Automobile Engineers in which they were asked to give their views on present tendencies in automobile design. Through lack of space it is impossible to publish all the replies received. Moreover, automobile engineers are fairly well agreed on the present tendencies, so that there would be considerable repetition were all the replies printed. It has been deemed advisable to select from the many letters received those which seem to express the views of most designers. In this selection subject matter has been considered, rather than the personality of the writer.*

We come into touch with the demands of automobile owners only indirectly through the unfinished (not machined) drop forgings we make for motor car manufacturers.

The great demand is for a more rigid adherence to a predetermined standard of chemical composition and physical properties. Indeed, there has been a great change in this respect in the past few years, for where formerly it was the exception for makers of motor cars to specify, except very loosely, the material to be used. They have now almost without exception, developed standard materials as to composition and strength for the various parts entering the construction of their cars.

The necessity of obtaining the maximum strength with the minimum weight has led to this result, which in turn has been made possible by the constant experimenting of chemical and physical testing laboratories established and maintained not only by automobile makers themselves, but also by makers of accessories and of their component parts.

HUGH WILKINSON,
Manager Manufacturing Department,
Brooklyn, New York. J. H. Williams & Co.

The things attracting most attention in the automobile industry to-day as we see it are the following:

1st. Electric starters.
2nd. Automatic spark advance.
3rd. Long stroke motors.

The electric starter should not only start the motor, but it must also take care of the lighting and ignition system. Must be built in one unit, and, if possible, constructed with the unit power plant. The question now agitating the best mechanics and designers as well as the public is whether this outfit can be built in connection with the motor to drive direct without gears, chain or other transmission devices or whether it shall be built in a separate unit and be driven in some manner from the motor.

The automatic control, if successfully worked out, will not only mean easier handling of the car, but will mean economy in operation and guard against accidents and a saving of wear and tear on the motor. We firmly believe that it will be sufficiently developed within a very short time, so that it will be almost universally adopted.

The changing from the short to the long stroke motor has been one of the most important made in motor construction in the past few years, but the question now concerning the public is how far to go with this. A number of the designers, especially those who have had but little experience with motor construction, or who have had no experience in any considerable number of sizes, seem to be going on the theory that if a little is good, more is better, and at least several cars already on the market have the stroke entirely too long in proportion to the bore in order to get the best results.

Both the designer and the public should understand that the best proportion of bore to the stroke on a motor designed for one purpose may not be, and, in fact, usually is not, the best proportion when used for another purpose. A motor designed for tractor or truck work and equipped with a governor, set at a maximum speed of 800 revolutions per minute should have th stroke longer in proportion to the bore than a motor designed for a pleasure vehicle supposed to have a maximum speed of 2,000 revolutions per minute or more.

Of the three things mentioned above there is but little doubt in our mind that the demand of the public for the electric starter is more vigorous than anything else, and for this reason it will naturally receive more attention from the manufacturer and designer for some time to come.

E. A. MYERS, *General Manager,*
Peru, Ind. Model Gas Engine Works.

It naturally seems from our point of view, that present tendencies in design and construction follow the insistent demands of the public, in the direction of new applications of electric current in connection with the gasoline automobile.

These developments have been particularly noticeable in electric starting devices and means for dynamo lighting. At the New York Automobile Show less than a year ago only one car was shown with an electric starter. At the next show there will be hardly a car of any pretensions which will not be so equipped. A year ago there was only one electrical starting equipment on the market, whereas to-day there are a dozen or more devices offered in a more or less highly developed form.

The refinement of means for lighting the car has been and will continue to be a notable feature. The old scheme of lighting by means of the storage battery charged from outside sources has not proven satisfactory on account of the variation in voltage during discharge. The incorporation of an electric dynamo in the design of the car does not present much of an engineering problem, but the control of the battery during charge presents a number of very interesting problems.

LOUIS RUTHENBURG, *Assistant Engineer,*
The Dayton Engineering Laboratories Company.
Dayton, Ohio.

The general tendency in design to-day is simplicity, serviceability, accessibility and harmony. Take the chassis. This is primarily designed for the size of motor that is to be used, and on this every other part depends. The aim here is to get the parts as few in number, as light and as easily assembled as possible for the service required. The body is designed primarily for the number of passengers and the service required. Harmony of lines, style and appearance and comfort of passengers are sought after. No two different makes of cars are alike in detail. Each engineer has his own ideas and works them out accordingly, and so we have a large variety of different ideas put into the various working parts.

To go more into detail of the parts that are used to make up a chassis, we will take the motor. Differences in construction of this part are numerous and oftentimes weird. The ratio between bore and stroke, the number of cylinders, the number of bearings on the crank-shaft, the construction of the piston and rings, the kind of valves—poppet or sleeve—how operated, the number of cam shafts, the shape of the cams, method of driving the cam shafts, gears and kinds of silent chains, the fuel system, the oiling system, the cooling system, the ignition system, the lighting and starting system, the method of mounting the motor, whether unit power plant or not, the material used in the different parts, etc.

Clutch.—Cone—Leather covered or metal to metal or cork insert. How and where mounted. Disk—Dry plate or running in oil. Kind and material of disks and number, where and how mounted.

Transmission.—Selective sliding gear mostly used. Number of forward speeds and on what speed the direct drive operates. Size, pitch and shape of teeth on gears. Method of shifting gears, where and how transmission is mounted.

Rear Axle.—Whether worm or bevel gear drive, whether pressed steel construction or built up with castings, whether full or semi-float. Kind and number of brakes. How operated. Drive of axle, whether by double universal joint and torque bar with buffer or concentric propeller shaft and rigid torque tube. With or without radius rods. Propulsion through radius rods or springs. Kind of differential.

Front Axle.—Whether solid I-beam forging or built up tubing.

Steering Gear.—Kind. Worm and gear or otherwise and where mounted—to left or right.

Control.—Brake and gear shift levers; how operated and where mounted—center, left or right.

Bearings.—Kind—ball, roller or plain.

Wheels.—Wood or steel.

Spring Suspension.—Shape and size of springs and how mounted and whether the chassis frame is over or underslung.

The manufacturer of to-day is virtually concerned in the building of a car which he can sell at a medium price with a profit, which will stay sold and which will satisfy the demands of the public—said demands being about everything conceivable.

C. M. FOSS,
Muncie, Ind. Interstate Automobile Company.

The trend of gas car design has been steadily toward the inherent qualities of the electric vehicle, namely: 1, noiselessness; 2, lack of vibration; 3, simple control; 4, self-starting of motor; 5, electric lighting; 6, reduction of speed; 7, reliability.

WALTER E. HOLLAND,
Chief Electrical Engineer,
Orange, N. J. Edison Storage Battery Company.

The present tendencies in design and construction are each season more nearly getting down to a standardized and uniform condition, as the general desire to have yearly differences existing is waning. The commercial stability of the automobile industry demands uniformity, as the success of motor building on the whole is controlled by the purchasing power of the many and the matter of cost of maintenance is a strong controlling factor, controlling the purchase of quantity.

Then again, with cars that are practically similar, value reductions that have been made in price, or the giving of many accessories and complete equipment at the same price—equivalent to a reduction of several hundred dollars per machine—makes more economical manufacturing a necessity. There are now many questions developing from any suggested change in design:

What's the change for?
What does it do?
Why should it be different?
In what way is it better?
Is it essential to better efficiency?

Is the change, if occasioned by appearance, one of obvious and general notice so far as the necessity of change is concerned?

Unless all of these questions are answered strongly and substantially, the cost of sacrificing the $50 or $100 that may be lost in abandoning the old tools or that might be required for the new tools is given serious consideration.

The tendency for lightness in construction is an important factor so far as it reduces the maintenance charge on the most expensive item, i. e., the tires. Then again, less fuel is required, which all together has its influence on the cost per mile in transit. These things are recognized, and naturally the efforts of any manufacturer to get down to too light a design, which will not stand the normal work put upon the machine, shows it up within a year or two to be *too* light and that the repair item of the maintenance charge is abnormal, along with the most serious inconvenience of having a car tied up while desired.

It has been gratifying to see the tendency of practically all of the automobile manufacturers to run toward quality and efficiency in steel parts used in both the chassis and motor construction.

While the item of additional expense being put into the steel is, of course, a vital one, it is carried further, such as more expensive wood selected for the wheels, and precautionary measures adopted, such as using cotter pins as guards for nuts, and other items running up into many dollars per car are expended merely to produce commercial stability which the layman cannot observe or appreciate.

Brooklyn, New York. FRANK W. MCCORD.

The present tendencies in the automobile world are toward consolidation, centralization and specialization in a business way, and in a mechanical way toward standardization of parts and the consequent use of fewer parts, simplification of design and general lightness of construction.

The general demand by the public is for a high grade of finish and general reliability in cars regardless of price, and on cars selling for one thousand dollars and upward it is necessary to supply self starters and electric lights.

Roomy comfortable seats both in front and tonneau of cars are demanded by buyers, and general easy riding qualities, whether the car be light or loaded, besides low cost of operation and easy accessibility of parts for lubrication and repair. Left-hand steer, particularly for city use, is growing in favor, although there are and probably always will be a large number of right-hand steer cars, particularly when the majority of the export trade demand right-hand steer.

The vital problems of the automobile industry to-day are:

a. Necessity for reduction in cost of marketing the product.

b. Necessity for lightening the general construction by simplifying and eliminating of parts.

c. Necessity for adequate carburetion, or in other words a carburetor which will function properly with the present low grades of gasoline, which very closely verges on kerosene.

d. Necessity for a self-starting and lighting outfit, the cost of which is very low, the application of which is inexpensive, the operation economical, and the weight of which will not run over fifty pounds.

e. Necessity for low cost of maintenance of operation, particularly as regards tire wear, which is about the greatest expense that the motorist is subjected to.

FRANK E. SMITH,
Newcastle, Ind. Maxwell-Briscoe Motor Company.

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The purpose of the Supplement is to publish the more important announcements of distinguished technologists, to digest significant articles that appear in European publications, and altogether to reflect the most advanced thought in science and industry throughout the world.

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